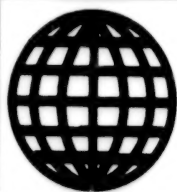


JPRS-EST-92-008  
12 MARCH 1992



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# ***JPRS Report***

# **Science & Technology**

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***Europe***

# Science & Technology Europe

JPRS-EST-92-008

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12 March 1992

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## ADVANCED MATERIALS

### France: Nickel, Cobalt Alloy Standards Created

92WS0300C Paris AFP SCIENCES in French  
10 Jan 92 pp 7, 8

[Text] Scientists generally use spectrometers to analyze the composition of metals, and they cannot do this without calibrated instruments. For certain grades of nickel and cobalt bases, no standard materials were certified. Under the umbrella of the Industrial Techniques Center (CTI), two centers—the Foundry Industrial Techniques Center (CTIF) and the Mechanical Engineering Industrial Technical Center (CETIM)—teamed up in 1990 to create certified European standards for noble alloys, specifically cobalt and nickel. The CTI now comprises 18 technical centers, including CETIM, CETIAT [expansion not provided], CTC [expansion not provided], and LRCCP [expansion not provided], among others. The CTIF is thus marrying its considerable experience in fabricating standard materials to CETIM's expertise in the composition analysis of cobalt and nickel. It all began with a market study and an exchange of views with different laboratories about which materials to make.

The centers selected Inconel 625 (a nickel alloy) and grade 6 Stellite (a cobalt alloy). They have already completed several steps in the process, including drafting the specifications sheet, fabricating the materials with the help of the best steelmakers, checking that the materials are homogeneous, and obtaining European reference numbers.

In 1992 the centers will submit the materials to 25 laboratories, which will produce the certified nickel and cobalt standards. They will request European certification from the Group of Certified European Standards Producers at the end of March 1992.

CETIM and CTIF will work together on calibrating and analytically verifying optical-emission and X-defluorescence spectrometers. Their work will make it safer to use cobalt and nickel alloys, especially as both are employed in hostile high-corrosion, high-temperature environments in aeronautic, nuclear, and surgical technology.

### Germany: Coating Fibers for Use at High Temperatures

92WS0325H Toddington NEW MATERIALS  
INTERNATIONAL in English Jan 92 p 7

[Article: "Germany: Coating Fibres for Use at High Temperatures"]

[Text] An installation which will allow carbon fibres to be coated with pyro-graphite and silicon carbide (SiC) in the same operating cycle is now being built by ABB Corporate Research in Heidelberg.

The group has worked since 1990 on the coating of continuous fibres for fibre-reinforced ceramics within

the scope of a joint project, partly funded by the German Ministry of Research and Technology. Its partner in this venture is Dornier Deutsche Aerospace, based in Friedrichshafen.

The project's goal is to manufacture damage-tolerant ceramics suitable for use at high operating temperatures over 1,200°C, under atmospheric conditions.

Dornier is planning to use these materials primarily in the aerospace sector. For these applications ABB is developing suitable methods for the deposition of slipping and oxidation-preventing interlayers on multifilament fibres, and is coating large batches of fibres with lengths up to 1,000 metres. Dornier is using the coated fibres to manufacture ceramic composites, which it then tests.

Of the candidate fibre materials for high-temperature applications, carbon fibres seem to offer the best chances of success due to their excellent temperature stability. For the moment, carbon has been chosen as the slipping layer and SiC as the interlayer protecting against oxidation.

Carbon coatings can be deposited by the thermal decomposition of volatile hydrocarbons. Chemical vapour deposition (CVD) coatings produced in this way are referred to as pyrocarbon or pyrographite. To date ABB has used toluene and acetylene as the carbon sources for pyrographite deposition.

The fibres are coated at reactor temperatures in the 1,000°C to 1,100°C range, at process pressures of 100hPa. The production of composites requires pyrographite coating thicknesses in the 30 to 100nm range.

Trichloromethylsilane (TMS) was used as the starting material in the first tests involving CVD of SiC coatings on carbon fibres. Due to the tendency of TMS to hydrolyze and because of its corrosive reaction products (HCl), this process is only suitable as a production method under certain conditions.

However, SiC deposition from silane (SiH<sub>4</sub>) and hydrocarbons, such as acetylene or ethylene, promises to be far less problematic. ABB is building an installation for this coating process at the moment. It will allow fibres to be coated with pyrographite and SiC in the same operating cycle.

According to ABB potential applications for multifilament fibre materials with modified or coated surfaces extend into electrotechnical areas, installation engineering, the aerospace industries and medical technologies. Coated fibres are conceivable for superconductor applications in electric power systems, while they are indispensable for manufacturing fibre-reinforced ceramics which should exhibit fracture toughness and thermal shock stability.

ABB believes that in the coming years, demand for fibres with special coatings or surface modifications is certain to grow substantially. It claims CVD is ideally suited for coating fibre bundles. The advantage of CVD lies not only in its considerable throwing power but also in the large number of layers which can be deposited.

Work being carried out at ABB Corporate Research, Heidelberg, has potential in the area of CVD-coated fibres which can be of great value in the coming years for the further development of fibre-based materials and composite materials, and help to speed up their introduction in innovative products and systems.

## AEROSPACE

### ESA To Transfer Space Technology to Industry

92BR0114 *Zellik INDUSTRIE in Dutch*  
Dec 91 pp 16-17

[Article signed F.E.: "Spacelink Commercializes European Space Technology"]

[Text] NASA has always encouraged its suppliers to sell their space-related developments to others, as well. For the first time, the European Space Agency [ESA] is also taking steps to do the same. To this effect, it formed Spacelink in association with the cofounders JRA Aerospace (UK), MST Aerospace (Germany), and Novespace (France).

ESA granted 130 million Belgian francs to Spacelink for a period of three years, in order to enable it to discover space developments which could also be a commercial success in other lines of business.

The promoter of the idea was JRA Aerospace. Two years ago, the company had already issued a catalog containing 55 space products for which it believed there was a market potential, especially in the nuclear industry, telecommunications, and robotics. AEA Technology, which presented three products, received 50 requests for more information.

ESA hopes that its 11 financial backers, including Belgium, will eventually be represented in Spacelink and that, from that moment on, Spacelink will become self-financing. The financial means will then have to come from licenses and from the transfer of technology.

### German Aerospace To Develop Ariane-5 Control Software

92MI0252 *WISSENSCHAFT WIRTSCHAFT POLITIK in German* 22 Jan 92 p 6

[Text] German Aerospace is developing the basic on-board control software for the new European launch rocket Ariane-5, the successor to the highly successful Ariane-4, which is currently in operation. One of the tasks of Ariane-5 will be to launch the European space shuttle Hermes, which is to supply the Columbus space

station. Matra Marconi Space has awarded German Aerospace a development contract worth 7.5 million German marks.

The high demands of space missions require the development of extremely reliable software. This will be achieved by complying with space quality standards and through extensive testing on simulators and on the original hardware. The planned 25-year service life requires great attention to maximizing maintenance capability.

The development of Ariane-5's on-board software follows on from German Aerospace's development of data systems for use in space projects, which are already in use in the Giotto comet probe, the faint object camera for the Hubble space telescope, the German X-ray satellite Rosat and the camera for the Russian Mars mission.

### France Launches International Space Year

92WS0322A *Paris AFP SCIENCES in French*  
16 Jan 92 pp 5, 6

[Article: "International Space Year Launched"]

[Text] Paris—The International Space Year [ISY] was officially launched in Europe on 14 January, at the Paris Observatory, by French Ministers of Research and Space, respectively Mr. Hubert Curien and Mr. Paul Quiles, and by directors and representatives of several European space agencies: ESA (European Space Agency), Italy's ASI (Italian Space Agency), France's CNES (National Center for Space Studies), and Germany's DARA (German Space Agency).

This ISY is expected to provide a medium for improving the coordination of international space programs devoted to the study and protection of planet earth, and to demonstrate to the general public the important part the space technologies it uses daily without being aware of them, can play in making better the lives of the planet's inhabitants.

"The International Space Year is an undertaking bent not on launching new programs, extravagant or not," said Mr. Curien, "but rather on showing the world the daily use that can be made of space and its technologies, in the fields of education, information in the broad sense of the term, and the distribution of data. The space effort is already providing, day after day, a superb example of international solidarity."

Mr. Quiles, for his part, remarked that: "Thanks to the European rocket Ariane, which launches 80 percent of the telecommunications satellites (...), Earth has become the global village of which McLuhan spoke." Many obstacles to the human conquest of space have yet to be surmounted. The first ones have been. Let us do what we can to make 1992 a banner year for the exploration and exploitation of space, because it is a formidable asset for Europe, for France, and for the world," he added.

As president of SAFISY [Space Agencies Forum for the International Space Year] and of the European Association for the International Space Year [EURISY], created for the event, Mr. Curien presided over the ceremony. As the world prepares to celebrate the 500th anniversary of the discovery of America by Christopher Columbus, space experts consider that as we near the end of the 20th century, after the moon missions and the sending of unmanned probes to the planets, and as flights to Mars are being prepared, space is today the equivalent of what the Indies were at the time of Ferdinand and Isabella the Catholic.

And with space budgets tending to be reduced or brought into question, these experts have thought it necessary to focus attention on the need for space technologies in socioeconomic development, and to increase international cooperation on improving living conditions on our planet.

"It is through the pooling of the data gathered in space on an international basis, through a permanent dialogue among scientists of different outlooks and origins, that maximum benefit can be derived from investments in space. And this is the modest objective, centered on scientific interest, of the International Space Year," said Mr. Curien.

Its promoters "know full well that money is a scarce resource. They also know that, in the space domain as in others, nothing is worse than having programs approved and not sufficiently funded. Avoiding the piling-up of ambitious but insufficiently funded programs throughout the world, and making better use instead, and in common, of what already exists: This is decidedly one of the goals of the International Space Year's programs."

"For the moment, the creating of a world space agency is out of the question," Mr. Curien acknowledged. "Space programs can only be implemented through technologically responsible agencies, but we can pool our efforts, exchange ideas, avoid duplications, listen to one another, and work better together for the good of all. The idea of launching an International Space Year germinated in the mind of an American senator, now deceased, Senator Matsunaga. We have taken it up and want to bring it into being."

Numerous events are being planned throughout the world in celebration of the ISY. The biggest event will be the International Space Congress, which is to be held in Washington from 28 August to 9 September, and which will be attended by thousands of experts. But already, from 30 March to 4 April, a conference to be held in Munich will enable scientists and engineers to exchange their experiences and their ideas on the theme: "Space at the Service of Global Changes." A way for the Europeans to launch preparations for future missions, while showing that the Old Continent has at its disposal the necessary scientific and human potential to enable it to play a leading role in space during the third millennium.

SAFISY's membership includes some 30 national and international space institutions. Its objective is to facilitate coordination and cooperation among them, so as to enhance the synergy among space programs, and in particular those that, like the ERS-1 satellite launched 1 July 1991 by an Ariane rocket, are devoted to the ongoing study and surveillance of Earth's environment.

### **French, German Firms Create Euro-Hermespace Company**

92WS0352F Brussels EUROPE in English  
25 Jan 92 p 18

[Text] **Aerospace:** Two months after the European Space Conference in Munich, four European industrial groups have created the firm EURO-HERMESPACE, responsible for the Hermes space plane programme. Situated in Colomiers, near Toulouse, it has a capital of FF250,000. The two French groups AEROSPATIALE and DASSAULT-AVIATION, regrouped under HERMES-FRANCE, hold 51.6 percent, against 33.4 percent for the German group DEUTSCHE AEROSPACE and 15 percent for the Italian group ALENIA. Mr. Johann Schaffer, managing director of DEUTSCHE AEROSPACE, has been appointed president of the new firm. The European Space Agency's (ESA) budget for 1992 is of ECU280 million (against the 320 million initially envisaged). Part of this budget is for infrastructure. EURO-HERMESPACE will have a budget of around ECU200 million, most of which will be paid to sub-contractors.

### **Matra Wins ESA Optical Communications System Contract**

92WS0352I Paris LA LETTRE HEBDOMADAIRE DU GIFAS in English No 1546-1, 9 Jan 92 p 1

[Text] On 3 December 1991, MATRA MARCONI SPACE signed a contract with the European Space Agency for development of the SILEX, a satellite oriented optical communications system. The contract is estimated to be worth 600 million francs. In 1985, MATRA MARCONI SPACE acted as prime contractor in collaboration with ESA and CNES to design the SILEX for high output digital transmission via laser beam between two satellites. One terminal will be installed on the Spot 4 observation satellite, travelling an orbit 800 km in altitude, to be launched in 1994. The other terminal will be installed on the ESA Artemis, geostationary satellite to be orbited in 1995 for real time relaying to the ground images received by the Spot 4 cameras. Twenty subcontractors of nine European countries will be working on the program. The SILEX will open the way to major technological breakthroughs in optics, pointing, telecommunications and automatic systems and will give Europe a leading position in the field of space applications, a field expected to develop substantially.

E2-MATRA MARCONI SPACE-9-1-1992-Contact: Mr. Frederic ARAGON - Phone: 33 (1) 40 69 16 72



## AUTOMOTIVE INDUSTRY

**France's CNAM Develops Diffusion Bonding**

92WS0334A Paris L'USINE NOUVELLE  
TECHNOLOGIES in French 23 Jan 92 p 13

[Article by Michel Vilnat: "Dynamic Diffusion Bonding Speed Records"—first paragraph is L'USINE NOUVELLE TECHNOLOGIES introduction]

[Text] The CNAM's [Museum and College of Technology] dynamic diffusion bonding process is already used to assemble alloy steel parts very quickly while improving the bond mechanical characteristics.

Thirty seconds to bond together the two parts of a 16-mm diameter drive shaft made of 27CD4 alloy steel; only inertia welding could have achieved such performance. But inertia welding would have altered the interface metallurgical structure and the part geometry, as a bead would have been formed.

A new process, called SDD (dynamic diffusion welding), developed by Martine Hourcade's team at the CNAM and patented with Renault, eliminates these drawbacks. Better still, it yields enhanced mechanical characteristics. The prototype could soon be manufactured industrially, provided a manufacturer is interested.

This new technique is based on the principle of diffusion bonding. But it differs from it in two essential respects: first, the pressure applied to the parts to be assembled is much higher (about 300 MPa versus 10 MPa or so with the old method); second, it uses induction heating. Much quicker than the traditional heating method using resistors, induction heating "affects" only a very limited area of the part. Its temperature (1050°C in this case) remains below the melting point of the 27CD4 alloy, so as to avoid recrystallization problems. As the pressure applied diminishes when the temperature increases, the metal does not reach its flow point, and deformation remain below 2 percent of the heated length. The part must be protected against oxidation; a mere neutral-gas sweep is usually adequate. On the other hand, the surface condition requires far more care than with inertia welding. Scouring and polishing are mandatory. However, the surface polish quality could be lowered by increasing the pressure and slightly increasing the duration of the operation. The first tests performed with surface conditions four times as rough yielded identical results, using a one-minute holding time. Of course, this technology is not just for steel; tests were also made on titanium-tantalum and Zircaloy-4-tantalum pairs. These are just a few examples.

**Citroen's "Flexible Cell" Reduces Manufacturing Time**

92WS0334B Paris L'USINE NOUVELLE  
TECHNOLOGIES in French 23 Jan 92 p 14

[Article by Marc Chabreuil: "Citroen Automates 'Just As Needed'"—first paragraph is L'USINE NOUVELLE TECHNOLOGIES introduction]

[Text] Citroen is replacing "full automation" with a flexible cell that is both economical and very efficient.

When it started operating one of the first flexible workshops, at Meudon back in 1983, Citroen Industrie reduced from 60 to 35 days the time required to manufacture a prototype cylinder head. Nine years later, a new facility named M3P (Prototype Parts Production Module) will manufacture the components of any power-train assembly in only 20 days.

For this, Citroen Industrie converted its flexible workshop into a flexible cell (two machining centers, automated tool and pallet magazines, and a three-dimensional measuring machines) to which a finishing workshop was added; the tight-flow operation is controlled by a MicroVax computer through two networks, Mapway and Ethernet. This "simplification" resulted in a 62 percent reduction of the floor area (420 m<sup>2</sup>) and a leap forward of the synthetic efficiency ratio (hours worked/working hours) from 69 to 82 percent. As for the investment, it did not exceed 12.5 million francs [Fr], including Fr6 million for the computer system. Compare with the Fr46 million of the former workshop... Actually, M3P marks a major development in the flexibility concept: "full automation" is replaced by the "just as needed" automation policy. For instance, wire-guided trolleys were eliminated (the magazines are right by the machines). The identification of each of the 536 tools used was found to be unnecessary (the computer monitors their movements), as was the hookup between the three-dimensional measuring machine and the central computer. Finally, human operators are back wherever they are more efficient or more "profitable" than machines; for instance, the finished quality is controlled by operators, and the washing-machine robot was eliminated.

"One half of the gains is due to our experience of the flexible workshop," Olivier Rousselle, M3P project leader, confided. The remainder comes from the use of standard, often overhauled, equipment, and computer systems which manage all of the workshop's resources in real time, based on TGAO [computer-aided group technology], GPAO [computer-aided production and operations management], and CAD [computer-aided design] data received through the Citroen SNA [Systems Network Architecture] network.

### France: Peugeot's Advanced Materials Research Reviewed

92WS0352H Brussels EUREKA NEWS in English  
Jan 92 p 12

[Text] EUREKA Project EU 13, CARMAT 2000, is quietly revolutionising the car manufacturing industry. Managed by French car manufacturer Peugeot S.A., it is devoted to developing new automobile materials and assembly processes.

"There is an enormous range of partners in this project, which reflects the variety of technologies we aim to develop," explains Mr. Languier, CARMAT technical coordinator for PSA. "What we have done is to divide the car into many different components, such as rear floor panel, windscreen, bonnet and so on, and assign each one to a different partner. Each will invent new materials and techniques for the manufacture and assembly of that part. Eventually, Peugeot will be able to "pick and choose" the best technologies."

Although the partners range in expertise from thermoplastics to steel, there are a number of themes common to their research. Many share the concept of developing larger components from smaller numbers of parts, to decrease assembly costs. Increased recycling and lower weight are other considerations, as is making panels better insulators of heat and noise. Resistance to impacts and corrosion is also sought.

"The hybrid approach," where different materials are combined, is one development that crops up again and again," notes Mr. Languier. "The resulting products synergistically combines the best characteristics of the different elements, and is often cheaper."

### Progress Evaluation

The project is currently evaluating the progress of each sub-project to date, before continuing with the most promising avenues of R&D. "CARMAT will definitely lead to an increase in the amount of plastic used in the car's structure, because we have learnt how to mould high-strength plastics into large sub-assemblies," continues Mr. Languier. "One example is the sandwich panel—a metal-plastic hybrid that has excellent thermal and acoustic insulation properties. It has never been easy to bond plastic and metal together, but several ingenious solutions developed under CARMAT mean that not only will body panels have better insulation properties, they will also be lighter and made from less components."

Not that we have ignored high-performance steel, which still has the best crash resistance. Steel, however, is difficult and expensive to stamp into the required shapes, so the computer modeling of stamping methods carried out recently looks quite exciting. We have also been looking at the use of aluminum."

Other ideas that look promising include the use of plastic fenders and composite absorbing systems. "If you accidentally bump a lamp post when parking, you have to

spend a fortune fixing the resulting dent. These new components will protect the car against such accidents far more effectively than today, and cost less to repair."

CARMAT 2000 also presents excellent opportunities for introducing more recycling into vehicle assembly and disposal processes. "CARMAT has particularly concentrated on designing all-plastic components that use assembly techniques which allow them to be easily disassembled," Mr. Languier adds. "Also, in line with CARMAT's objectives, PSA is participating in RECAP, an important EUREKA Environment recycling project for the car industry."

In the end, Peugeot will evaluate the different options opened to the company by this EUREKA project. "The final stage will involve manufacturing a complete prototype car. It may have a plastic hood, composite fenders, hybrid doors and a "new steel" chassis, or some other combination. It's still too early to say exactly how it will look, but I do know that it will represent a future European car industry that can take on the best the world can offer."

## BIOTECHNOLOGY

### Germany: Genetically Modified Plants Defeat Effects of Pesticides

92MI0225 Bonn DIE WELT in German 20 Jan 92 p 19

[Article by Michael Lange: "Unforeseeable Environmental Consequences—A Genetically Manipulated Tobacco Plant Can Turn Herbicides into Fertilizer"]

[Excerpt] [Passage omitted] Professor Guido Hartmann and his colleagues at Munich University's Institute of Biochemistry have now succeeded in modifying tobacco plants so that they not only convert a herbicide, but are able to recycle the substance so created and to do so in such a way that no dangerous substances remain in the plant. An enzyme that the researchers found in the soil fungus *myrothecium verrucaria* is responsible for this. It enables the fungus to convert the herbicide cyanamide, which is used in vegetable and hop growing, for example, into urea.

The biochemists used what are now well-established genetic engineering methods to isolate the gene that stores the enzyme formation information from the fungus' genetic material and transfer it into the tobacco cells. In order to do this, they first made a "gene cassette," packaging the gene into the genetic information of the cauliflower mosaic virus. *Agrobacterium tumefaciens*, a microorganism that is frequently used as a "gene ferry," was then used to carry the fungus gene into the plant cells.

When the scientists had regenerated the manipulated tobacco cells again to form complete plants, they were able to measure the activity of the fungus enzyme in 15 specimens. The enzyme converted sprayed cyanamide



into urea in both the roots and the leaves. This made the plants resistant. Spraying with the 5 percent cyanamide solution usual in agriculture, had no further effect on them.

The urea produced is not just a harmless waste product: The plants can process it further because enzymes involved in plant metabolism release the nitrogen content of the urea as ammonium. This is a valuable nutrient for all plants, as it ensures they are supplied with nitrogen. As a result, cyanamide actually promotes the growth of the tobacco plants: The herbicide becomes a fertilizer.

If the genetic engineers succeed in equipping other crop plants with the resistance gene from the fungus in the same way as with the genetic model tobacco, plant protective cyanamide, which has been little used to date, will doubtless have a brilliant future, much to the delight of its manufacturer Trostberg, which sponsored the Munich biochemists' work jointly with the Chemical Industry Fund.

However, the recent successes of this privately-sponsored research do present an ecological problem. Although the herbicide is highly biodegradable, if it is sprayed onto fields in excessive quantities it could damage the soil or find its way into the ground water. The danger of the farmer using too much of the poison would be higher than with other herbicides because it would have no harmful effects on crops. Like every new herbicide-resistant plant, the new tobacco represents an additional threat to the already dwindling variety of species to be found in and near fields.

### British Firm Develops Hepatitis A Vaccine

92WS0286B Paris LE MONDE in French  
18 Jan 92 p 11

[Article by Franck Nouchi: "Hepatitis A Vaccine Developed"]

[Text] On Wednesday 15 January, British pharmaceutical firm SmithKline Beecham announced that it had developed a vaccine for immunization against Hepatitis A. It is being manufactured at Rixensart in Belgium and is called Havrix. It is expected to be marketed this year in Europe. It is the first efficacious vaccine against this form of hepatitis, which may occur sporadically, or, on the contrary, in epidemic form.

Virus A is transmitted by fecal-oral contact, water and food being the principal vehicles of contamination. There are no efficacious treatments against the A virus.

On the other hand, prophylactic measures (prevention of fecal contamination of water, purification and monitoring of drinking water, sanitary inspection of food eaten raw, and administering of immunoglobulins during the first two weeks following exposure) provide protection against the occurrence of clinically apparent hepatitis in 80 to 90 percent of the cases.

### Disappearance of Immunity to VHA

According to a study published on 15 July 1991 in BULLETIN EPIDEMIOLOGIQUE HEBDOMADAIRE, a rapid decrease of anti-Virus A antibodies, probably owing to improvement in sanitary conditions, is being observed in France.

If this trend continues, a great majority of France's children may have no immunity to VHA [Viral Hepatitis A] by the year 2000. It is estimated that 40 percent of 11- to 15-year-olds presently have anti-viral A antibodies. The consequences would be an increased risk of developing occasionally serious cases of hepatitis, and an increased risk of an epidemic.

The authors of the study conclude that commercialization of the vaccine "will probably bring a solution to what could become a major public health problem in the years to come."

### Analysis of Swiss Laws on Genetic Technology

92WS0315 Zurich NEUE ZUERCHER ZEITUNG  
(INTERNATIONAL EDITION) in German 29 Jan 92  
pp 41-42

[Article by Othmar Kaeppli: "Regulation of Biotechnology and Genetic Engineering"]

[Excerpts]

### Methods of Regulation

The need for regulation within the fields of biotechnology and genetic engineering can be satisfied in various ways:

- Existing regulations can be reviewed to determine whether they are applicable to the new technology, and then either interpreted correspondingly ("creative interpretation") or adapted and expanded via technology-specific text.
- A new, original model law can be created that meets the need for laws governing biotechnology and genetic engineering (enabling statute).

Switzerland plans to employ the first method of regulation, according to which existing laws are expanded. This method is the model for both the current expansion of the constitution, which consists of an article on reproductive and genetic engineering, and the revision of the Environmental Protection Law, the Patent Law, and the Food Law.

Due to the Swiss legislative procedure, the regulation process is extremely time-consuming, and routine adjustments are virtually impossible. This works to the detriment of a rapidly developing technology. The legislative process itself takes several years, and implementing it in the form of decrees takes another several years. Consequently, there is only one regulation explicitly governing biotechnology: the regulation based on the law covering accidents at nuclear power plants. The

latter was expanded via a "creative interpretation" of the Environmental Protection Law to apply to the use of microorganisms in closed systems. The regulation, which took effect on 1 April 1991, is intended to protect the population and the environment from serious harm in the wake of accidents in factories containing hazardous materials, products, and waste products as well as in those using microorganisms.

The employment of existing laws and decrees has proved useful for controlling the distribution of products manufactured via genetic engineering. According to a response by the Federal Council to a parliamentary inquiry, 33 medications containing active ingredients produced via genetic engineering were registered with the Inter-Cantonal Control Office for Medications (IKS) in February 1991. The Federal Health Department authorized the use of vaccines against Hepatitis B in Switzerland. In the field of veterinary medicine, two vaccines and a rennin (lab) produced via genetic engineering were approved.

This shows that, depending on the product and field of application, not only do various laws and decrees apply, but various governmental offices are involved. In 1986, in order to coordinate this work and the licensing procedures between the responsible authorities, the Coordination Office for Licensing Procedures for the Use of Recombinant Organisms (KOBAGO) was established. KOBAGO is affiliated with the Federal Agricultural Office.

#### Guidelines From Professional Organizations

In addition to the legally binding regulations of the Nuclear Accident Law, there are also guidelines issued by various Swiss professional organizations. Although these are not legally binding, they are normally followed, because they represent a generally accepted standard. Because genetic engineering involves the basic building blocks of life, the scientists involved in this field agreed early in the history of genetic engineering to establish guidelines for their work. In 1975, the Swiss Academy of Medical Scientists (SAMW) formed the Commission for Experimental Genetic Engineering, which adopted for Switzerland the guidelines established by the American National Institutes of Health (NIH). Of particular importance is that, as of 1977, all genetic engineering projects have been registered. In the mid-80s, the SAMW issued medical-ethical guidelines prohibiting the manipulation of the genotype of gametes and embryos. In 1986, the Swiss Academies for Natural Science, Medicine, and Engineering Sciences founded the Swiss Interdisciplinary Commission for Biological Safety in Research and Technology (SKBS) as the successor to the Commission for Experimental Genetics. The guidelines formulated for the United States by the NIH, supplemented by recommendations by the OECD, were declared binding for Switzerland. In accordance with accepted standards, genetic engineering projects are registered annually. In 1990, these totaled 244 projects involving 977 participants.

On 1 January 1992, the SKBS released its own guidelines, which were essentially based on those of the NIH, the EC, the OECD, and on the German Genetic Engineering Law. They apply to the use of organisms modified through genetic engineering in closed and open systems.

#### Future Regulations

Even today, the many possibilities for the use of genetic engineering fall primarily in areas for which there are constitutional bases for federal legislative jurisdiction. A complete overview of these bases is provided in the 18 September 1989 statement by the Federal Council on the peoples' initiative "Against the Misuse of Reproductive and Genetic Engineering in Human Beings." The counterproposal by the National Council and the Council of States to the "Observer Initiative," should it be ratified by the people, will result in a constitutional amendment. This amendment will be able to be used as the basis for regulating the employment of genetic engineering in both human genetics and biotechnology, as it is based on a single concept of protection, the "Protection from Misuse."

At the legislative level, the process of revising the Environmental Protection Law is underway. The revision is centered around the new chapter on environmentally hazardous organisms, and is designed to link a regulation to the Environmental Protection Law that will:

- close the known legal gaps (especially concerning release and marketing) and ensure sufficient consideration of the environmental impact;
- facilitate responsible research, development, and use of biotechnology and genetic engineering;
- be coordinated with planned European laws.

Federal Council bills calling for a new Food Law and a revision of the Patent Law also contain a reference to biotechnology and genetic engineering. Both proposals may be opened to parliamentary debate. The commentaries on the May 1990 proposal by the Ministry of Interior for a revision of the Environmental Protection Law contain a list of the current legal structures that apply to the biotechnological field and could therefore serve as the basis for a regulation.

#### Technical Support

Because biotechnology and genetic engineering have been regulated via the adaptation of existing laws, Swiss law contains very few specific guiding principles for these fields. Nonetheless, it has been established that in both human genetics and biotechnology, the probable regulations (articles of the constitution, the Environmental Protection Law) are no more restrictive than other methods of regulation (within the EC, Germany, and other European countries). The need for coordination has been recognized and is being met.

On the whole, the path to the regulation of biotechnology and genetic engineering in Switzerland is proving rather

rocky, and holds the danger that the gradual adaptation of laws will lead to over-regulation and an unpredictable judicial system. As far as this system is concerned, expertise and adaptability will be of primary importance. With decentralized methods of regulation, it is often difficult to ensure that there is sufficient expertise among the individual offices of the judicial system. This results in a demand for a technical office to support the cantonal offices. This technical office should be a federal institution composed of recognized, incorruptible individuals with demonstrated knowledge within the technological field. The Interdisciplinary Swiss Commission for Biological Safety in Research and Technology comes close to meeting the stated requirements; however, it lacks, among other things, a legal basis, regulations on personnel structure, a clearly formulated mission, and an adequate infrastructure.

### The Search for Stable Regulations

An objective public debate on biotechnology and genetic engineering is essential in order to weigh the risks and benefits. This debate must establish the basic values that can be formulated on the basis of the general conditions tied to these two fields. The experience gained during the licensing procedure for the Ciba-Geigy College of Biotechnology in Basel confirms that a lack of binding regulations leads to a situation which is highly satisfactory to the opponents. The judicial system proved extremely sensitive to politics and the weight of public opinion. While it is true that legal regulations cannot always prevent such a situation, they do provide public authorities with a legal justification and applicants with a right to licensing, provided they have satisfied the legal prerequisites.

In addition to clear limits for the use of biotechnology on humans, genetic engineering also needs a clear legal framework that provides precise procedures. Because this regulation must be based on objective requirements, it requires a combination of judicial and natural science expertise. It remains to be seen whether the Swiss decision to regulate these fields by adapting existing laws can achieve the stated objective, or whether it will result in an even less predictable judicial system. The creation of objective and reliable general conditions can be put off no longer if we are to promote the responsible development of modern biotechnology and avoid its irrevocable and economically detrimental mutation.

## COMPUTERS

### French University Computer Research Outlined

92BR0121 *Le Chesnay BULLETIN DE LIAISON DE LA RECHERCHE EN INFORMATIQUE ET EN AUTOMATIQUE in French No 134, 1991, pp 2-6*

[Article by J. P. Verjus: "The Grenoble Applied Mathematics and Information Sciences Institute (IMAG)"]

[Excerpts] The Grenoble Applied Mathematics and Information Sciences (IMAG) Institute is a joint research group shared by the CNRS [National Center for Scientific Research], the Grenoble National Polytechnical Institute (INPG), Joseph Fourier University (UJF), and the Lyon Graduate School (ENSL); it is made up of nine laboratories and joint departments. The institute is in charge of coordinating research, essentially on the basis of setting up projects, training Ph.D.'s, and managing common resources.

The IMAG laboratories and departments are described in this article in the form of summaries. They include 700 persons, including 160 teachers, 90 researchers, 90 ITA [engineering, technical, or administrative] functions, 40 engineers from industry or under contract, and over 300 graduate students. The consolidated 1990 budget (160 million French francs [Fr]) shows that the IMAG Institute is, first of all, a university laboratory (36 percent of the funds), which is very much directed toward the social and economic sector (over 22 percent of the funds are contractual) and solidly supported by the CNRS (20 percent of the funds). The budget without statutory salaries (Fr50 million in 1990) is largely derived from contracts (72 percent); the total share of the Ministry of National Education is on the order of 14 percent, that of the CNRS 8.5 percent, and that of local communities 5.5 percent.

Its research covers the entire range of fundamental and applied research in computer science and applied mathematics. Its researchers are members and often driving forces of all the national programs in computer science, mathematics and signal processing conducted within the CNRS' GRECO [Coordinated Research Group] and the coordinated research programs (PRC) of the Ministry of Research and Technology. They carry on international activity that is corroborated by over 300 publications in international periodicals or colloquia every year.

As to the numbers of young French or foreign research scientists graduating, an average of 55 theses per year (calculated over the last four years) is accepted.

IMAG is also playing a major part in European programs, with ESPRIT [European Strategic Program for R&D in Information Technologies] in first position (13 projects in ESPRIT I, including 11 completed; 14 projects in ESPRIT II, all under way); IMAG has an exceptional share in fundamental research (11 BRA [basic research action] projects out of 14 projects in ESPRIT II). The other European programs in which IMAG is currently involved include AIM [Advanced Informatics in Medicine] (four projects), EUREKA (two projects), COMAC [Concerted Action Committee], BRITE-EURAM [Basic Research in Industrial Technologies for Europe/European Research on Advanced Materials], Health and Medical Research, and STIMULATION.

Relations with industry and transfers are one of the good IMAG traditions:

Joint projects with the IBM Research Centers, then with Bull, creation of companies (Aleph Technologies, Alma, Getris, ITMI [Intelligent Machines Technology and Industry], B'Vital), training through research in joint research/industry cooperative schemes, and joint research/industry projects. Some 50 different companies are involved in various relationships with IMAG.

#### **IMAG Projects**

The 13 IMAG projects involve about 250 persons, half of them graduate students. The list is given below in the order of creation since 1988.

#### **GUIDE**

Project leaders: R. Balter and S. Krakowiak

Its goal is design and development of a distributed system (a joint project between Bull and IMAG). It is conducted in cooperation with the Grenoble research center of Open Software Foundation (OSF) within the scope of the ESPRIT "COMMANDOS" project. The joint Bull-IMAG "Systems" research unit was created around this project and the OPERA project on 1 January 1990.

#### **SPECTRE**

Project leader: J. Sifakis

The goal of the SPECTRE [Strategic Project for European CMOS [complementary metal-oxide semiconductor] Technology Research and Exploitation] project is programming of real-time and distributed systems; it is conducted within the scope of the ESPRIT "DELTA-4" [Development of European Learning Through Technological Advance] project in close cooperation with Merlin Gerin and Verilog.

#### **SHERPA**

Project leader: F. Rechenmann

Its goal is the study of basic knowledge and its utilization within intelligent computer-aided modeling systems with applications in automation, biology, and mathematical engineering; this project is a joint IMAG-INRIA [National Institute for Research on Information Science and Automation] project and is carried out in close cooperation with Ilog and Capsesa.

#### **CMaP**

Project leader: B. Plateau

Its goal is study and development of software and applications on massively parallel machines. The workshop, which is equipped with a 32-processor hypercube FPS-T-40 and Meganodes machines (developed by Telmat in the framework of the ESPRIT "Supernode" project), is the national test center for parallel machines within GRECO-PRC C<sup>3</sup>. This project is supported by the Ministry of National Education, the Ministry for

Research and Technology, the CNRS, and the Rhone-Alpes regional authorities within the 1989-1993 plan. Cooperation on this topic has started with IBM as well as small French manufacturers (Archipel, Telmat).

#### **ARISTOTE**

Project leader: M. Adiba

This project involves the study of multimedia databases which incorporate various forms of information display in coordination with users and companies developing applications in software engineering, office systems, cartography, medicine, document research, etc. This project is conducted in cooperation with GIP [public interest group] Altair and Matra BD.

#### **DESIR II**

Project leader: J. Della Dora

Involves development of formal calculation software for solving differential equations in a complex field; these very voracious software programs must be implemented on parallel machines. This project is to be done in cooperation with IBM.

#### **Computer Science and Nervous System [ISN]**

Project leader: J. Demongeot

Involves the development of image analysis methods and software in medicine, in particular for controlling microsurgery robots. This project is being developed in the framework of European cooperation, in particular with Siemens, and is done in partnership with DEC.

#### **SHARP**

Project leader: C. Laugler

Involves decision problems in mobile robots; the work is conducted in a European framework in cooperation with ITMI, Aleph Technologies, and Robosoft as well as with users, such as PSA [Peugeot]. This project is part of the Research Group on Space Robotics (RISP) which was set up with the CNES [National Center for Space Studies], CNRS, INRIA, CERT [Toulouse Study and Research Center], and the AEC [European Ceramics Association].

#### **CABRI-Geometer**

Project leader: J. M. Laborde

Involves continued studies of courseware for intelligently assisted teaching of geometry. The software has already been implemented and has won an award from Apple.

#### **SCOP**

Project leader: D. Bert

Involves specification and compilation of programs on formal program specification, transformation, and synthesis methods, following work done by the team on



generic programming and LPG [programming and control language]. The idea is to define a set of tools for computer-aided program compilation. This work is done in cooperation with many organizations, in particular with Syseca and DEC in the framework of ESPRIT.

### OPERA

Project leader: V. Quint

Involves production of structured documents; this project aims to continue R&D conducted for five years on the Grif editor and its industrial version, which was developed by GIPSI SA [Public Interest Group for Science and Information Processing]. This project will be conducted jointly by the Grenoble team and a team from the Rennes-based INRIA center. It is the subject of cooperation with many industrial companies, including Cap-Sesa, within the framework of the European ESF [European Software Factory] project.

### DEPAR

Project leader: R. Caferra

This project involves the utilization of general automatic deduction and testing tools for specifying and proving the properties of parallel programs. This project involves two teams that are specialized initially in automatic deduction and parallelism. Its tools are to be developed in cooperation with Syseca.

### IDOPT

Project leader: J. Blum

Involves (determinist and stochastic) methods for optimizing and identifying systems that are governed by partial differential equations. In conjunction with the SHERPA project, this project has developed the EVE expert software for solving these problems. This research is conducted in cooperation with the CEA [Atomic Energy Commission] and CISI [International Company for Computer Services], the European JET [Joint European Torus], and NET [Next European Torus] projects, CESTA [Aquitaine Scientific and Technical Study Center], and LETI [Laboratory for Electronics and Information Technologies]. [passage omitted]

### IMAG's Four Research Programs

IMAG's scientific activity can be presented within four major scientific areas, each of which employs 100-150 persons. Three of these areas involve computer science, corresponding respectively to R&D on hardware, basic software, and advanced software and applications. The fourth area concerns discrete and applied mathematics.

### Machines and Systems Architectures, Parallel Systems

Research conducted within this program aims to improve the efficiency, productivity, and operating reliability of data processing machines and systems, in particular by improving their performances and by interconnecting them.

Performance is improved through increasingly integrating hardware or by applying multiprocessors operating in parallel or massively parallel machines. Interconnection of systems through local, national, or international networks permits information exchange among scientists, as well as increasingly better distribution of the workload and more efficient utilization of all the resources: Computer science is distributed like electricity, in a transparent manner almost everywhere.

In these subjects, emphasis is placed on studying massively parallel machines (CMaP project), network-based open systems (GUIDE project with Bull as partner), and multimedia databases (ARISTOTE project). Design and manufacture of circuits and study of the architecture of new machines (linked to the establishment of new engineering courses) also mobilize many research scientists. This sector includes about 150 persons.

During the next four years, we plan new activities or projects on the following subjects:

- Circuit testing;
- Architectures for telecommunications;
- Networks and distributed systems (in particular, upon the 1993 completion of the prototype built by Bull-IMAG).

### Programming and Software Engineering

Research at the software level is being conducted to improve reliability and productivity in design and implementation of programs and systems. In particular, fundamental as well as applied studies are being undertaken to develop new programming languages that make it possible to specify and produce programs and test their accuracy. On this topic, emphasis is placed on specifying, producing, and testing sequential programs (SCOP project), parallel programs (DEPAR project), and distributed and/or real-time (SPECTRE project) programs. As a complement to this activity, which is very apparent at IMAG, research should be stepped up in software for management environments, maintenance, and reusable software, as well as research aimed at the development of advanced interfaces. This sector includes about 150 persons.

In the next four years, we plan new activities or projects on the following subjects:

- Software engineering and programming environments;
- Interfaces and ergonomics.

[passage omitted] IMAG research focuses on the fundamental level, general tools (SHERPA project), and applications in the following fields: imaging and robotics in medicine (Computer Science and Nervous Systems (ISN) project); vision; robotics; remote handling (SHARP project); computer-aided teaching; computer-aided translation; computer-aided publication of documents (CABRI and OPERA projects). This sector includes about 150 persons.

The partnership project with INRIA, which was slated to begin as of 1991 in the form of a joint laboratory, has been developed from the start on projects that come under this topic.

In the next four years, new activities or projects are planned on the following subjects:

- Neural networks;
- Computer vision;
- Imaging and biomedical applications;
- Natural language processing.

#### **Discrete and Applied Mathematics**

This area involves, on the one hand, research based on the theory of graphs, discrete combinatory analysis, and algorithmic mathematics—the best known applications of which are the elaboration of computer-aided decision-making models (in industrial automation, computer-aided systems)—and, on the other hand, research that is traditionally linked to mathematics but that distinguishes itself, in particular in Grenoble, by the intensive use of computer science as a support and advanced tool in computer-aided design and computer-aided implementation of applications. The planned research activities in this second area involve the study of high-level numerical methodologies, the use of parallel systems and expert systems in scientific computing, and the integration of numerical, formal, and graphic calculation techniques in a single system. It should be noted that IMAG has just been chosen as French representative of the European network for industrial mathematics.

Ongoing projects (DESIR II project for formal calculation and IDOPT project for solving differential equations) are dedicated to intensive scientific calculations. A partnership with IBM is considered on this latter subject in conjunction with studies on parallel systems. Some of the researchers in discrete mathematics are working on the CABRI-Geometer project, and others are involved in cooperative projects aimed at defining research problems specific to industrial engineering.

In the next four years, new activities or projects are planned on the following subjects:

- Industrial engineering;
- Algorithmic geometry;
- Systems reliability and performance evaluation. [passage omitted]

#### **Partnerships**

By definition, the partnerships between the IMAG Institute and other organizations are based on one or several IMAG projects. On this basis, we aim, on the one hand, to establish long-term relationships with the EPST's [Public Science and Technology Establishments] (INRIA and INSERM [National Institute for Health and Medical Research]) and, on the other hand, to set up cooperation agreements with manufacturers.

#### **Joint Laboratories with INRIA and INSERM**

The goal of the partnership with INRIA is to formalize the status of the three projects to which four INRIA researchers and two INRIA engineers are assigned, and whose three project leaders are all research directors of INRIA. These projects are "joint" in that they involve both IMAG and INRIA researchers and that they are accepted and evaluated by the authorities of both institutes in accordance with their research priorities. These three projects are OPERA, SHARP, and SHERPA. They include 35 persons, including 15 full-time employees (six INRIA, four CNRS, five Ministry of National Education). Two other joint projects are planned on the subjects of vision and ergonomics.

We planned to formalize this partnership as of 1991 by an agreement between IMAG and INRIA which specifies the status and the operating procedures of these joint projects within the framework of a joint laboratory. This structure should benefit from support by the Rhone-Alps region and the Isere Department.

The research activities in the field "Computerized Medicine" will be rearranged in 1991 in a research unit which could have the status of a mixed research unit between INSERM (section 09) and CNRS (section 08). This unit will work on projects related to the subjects of computer science and nervous system (ISN, existing project), neural networks, and imaging (projects to be created).

#### **Cooperation with Bull and DEC**

In May 1989, Bull and IMAG created a Mixed Research Unit around the GUIDE and OPERA projects. Its goal is to implement a prototype of a distributed system and a pilot application in the field of document processing. The unit's operations and facilities have been insured for four years by the founding parties, the EC, and the regional communities. This new unit has been located since May 1989 on premises leased by Bull in the immediate vicinity of the research center of the Open Software Foundation (OSF, association of manufacturers, including IBM, DEC, HP, Apollo, Bull, and others). Its siting in Grenoble was motivated, among others, by the desire to cooperate with the IMAG researchers. The creation of this unit of researchers and engineers (25 to start with, 40 in the short term between OSF and Bull-IMAG) should eventually constitute a



research center specialized in distributed computer systems that would be unique in Europe. New developments are expected on this subject in cooperation among IMAG, INRIA, and the manufacturers of the OSF consortium.

The partnership with Digital took the form of a three-year contract that was signed at the end of 1989 with this company, J. Fourier University (on behalf of IMAG), and the University Hospital Center. This contract implies consistent support by Digital in the fields of equipment and human resources. It involves three subjects: computer-aided image manipulation [imagerie interventionniste], neural networks and "hybrid" expert systems, and integrated hospital information systems. Negotiations are currently under way to complete this contract by a cooperative effort on a massively parallel machine which would be one of the strong points of the "cognitive sciences" project and of the "imaging and biomedical applications" project. Other contracts are also being negotiated at this time around the SPECTRE and SCOP (Specification and Programming) projects.

#### **EC Develops Object-Oriented Operating System**

92BR0176 Nanterre LA LETTRE DE  
L'INTELLIGENCE ARTIFICIELLE in French  
Dec 91 p 8

[Unsigned article: "Object-Oriented Operating System in the Preindustrial Stage: COMANDOS"]

[Text] COMANDOS [Construction and Management of Distributed Office Systems"] started in 1986 as a project in the ESPRIT [European Strategic Program for Research and Development in Information Technology]. Today, it is almost completed (phase two ends in 1992). Like several projects (for example, the ISA [International Space Agency] project or, outside ESPRIT, the Distributed Computing Environment within the OSF [Open Software Factory] project), the goal of the project has been to define a platform for integrating heterogeneous distributed systems. A particular feature of COMANDOS is the choice of its initial concept: integration of the aspects of the operating system; data and languages management based on a single paradigm; and the object-oriented model. Implementation of heterogeneous distributed systems requires, one way or another, the integration of these three key features. However, the objects give a uniform picture of the system; for example, they at the same time constitute a programming abstraction and the nonvolatile memory storage unit (which is called the "continuous programming" approach). Likewise, the interface of one object can handle various applications, and a single object may be shared by different subsystems; in the latter case, it functions as a communications abstractor.

Thus, the COMANDOS implementation developed at the Bull-IMAG [Grenoble Applied Mathematics and Information Sciences] research center (Bull is leading the

COMANDOS project) is really an object-oriented operating system. It is this system, called Guide [Grenoble University Integrated Distributed Environment], which is briefly described below.

Within GUIDE, the object-oriented model is implemented in a language, also called GUIDE, integrating the type and class concepts with simple inheritance. Externally, the system has the following characteristics:

- Continuous object management;
- Transparent object distribution on the local network;
- Distributed and concurrent execution model; the execution units are virtual multioperation (multithread) machines, which can be dynamically implemented in several locations;
- The objects can be synchronized and the system can handle transaction transfers.

Development of the GUIDE language was a deliberate choice made by the software designers, who apparently were not worried about contributing the antepenultimate revelation on the subject. The interesting thing about this new language is that it implements all the concepts of a virtual COMANDOS machine and gives direct access to all its applications. Having said that, it stands to reason that the COMANDOS platform is intended to support existing languages; execution environments for C++ and Eiffel are under development. The essential point is that it allows simultaneous processing of objects created in different languages: COMANDOS allows cross-accessing of objects written in different languages. This is no more mysterious than a traditional call to a library subprogram. COMANDOS is different in that the link is dynamic; the system provides a specific service: type management. This is a database for types, which is updated each time a new type is created.

Continuous object management dispels the idea of files and their management. For the user, there is no longer a difference between objects which "outlive" the program's execution and other types. With this in mind, the system has its own storage system performing the basic functions of an object-oriented DBMS [data base management system]. Thus, the objects written in GUIDE-language serve as standard recording "format" into which objects created in other languages are translated (which is, after all, no more startling than the diverse "file formats" of traditional operating systems). The COMANDOS model includes a type model (said to be "canonical") which is used as a reference for translating ("mapping") type systems of different languages. This "canonical model" is based on recent developments (1985) in language theory. It plays an essential role in the operation of the type manager, on which interlanguage communication relies.

Object distribution is managed entirely by the system; at the language level it makes no distinction between local and remote object-accessing (the explicit controller is nevertheless supplied on an optional basis). This makes it possible to develop an application at one site and

subsequently distribute it over the network without any modification. An electronic-mail program has been successfully set up at Grenoble using this method.

The COMANDOS execution model separates the objects from the execution structures; i.e., the objects are passive. In this respect, the choice between active or passive objects is one of the major issues in systems design. In the first case, each object defines one or several processes; in the second, the objects are activated by processes independently defined in the system. Since COMANDOS was designed to manage "fine grain" objects (the objects can be "small" and "numerous"), performance considerations prevailed over the concern for design uniformity and the second option was chosen.

Three implementations of COMANDOS/GUIDE have been developed by the Bull/IMAG research center. The first runs on Unix, the two others on "microkernels": OSF/Mach and Chorus. As one would expect, Unix imposed great limitations on the implementation of a system like GUIDE. "In almost every part of the kernel (of GUIDE), standard Unix mechanisms had to be bypassed, modified, or used with prudence," confirmed the authors of the initial comparative report. On the contrary, the design "philosophy" underlying Chorus or Mach adapts well to the object-oriented approach. Technically, Unix is the best example of a design model outmoded at the industrial level; but that is another story.

### **German Neural Computing Institute Develops Face-Recognition System**

92MI0251 Bonn WISSENSCHAFT WIRTSCHAFT POLITIK in German 22 Jan 92 p 3

[Text] Computers able to recognize human faces have now been developed by scientists in Bochum, thus paving the way for an "electronic janitor" that "notes" video recordings of faces in great detail and can thus admit authorized or keep out unauthorized persons. The computer is not even fooled by a three-day beard or by changes in facial expression. This new development is the work of a team of scientists at the Institute of Neural Computing at the Ruhr University, Bochum, led by Professor Christoph von der Malsburg. The new system, funded by the Federal Ministry of Research and Technology, has been implemented on a transputer-based parallel computer, as conventional computers do not have the very high computing power required. Apart from the janitor application, the basic algorithms have a wide-ranging potential in industrial production, robotics, and medical technology applications requiring recognition.

This ability, hitherto only possessed by humans, of mentally reconstructing the whole of a puzzle even with details missing, is now shared by computers owing to a mathematical process (wavelet transformation) that assigns each image dot a code that is then represented in the computer by a series of digits. The particular advantage of these special codes is that they alter only slightly

in relation to changes in facial expression, angle of vision, etc. A grid of dots is superimposed over the face, and the codes are stored at the grid points, so that, in time, the database acquires a large number of facial images coded in this way. This reference database is then used in a neural network to identify faces recorded with a video camera.

The Ruhr University's Institute of Neural Information Systems is presenting its new face-recognition system at this year's Hanover Industrial Fair jointly with two companies, GNI of Bochum and Parsytec of Aachen. It will form part of an exhibition by the North Rhine Westphalia Science Center and the land's Ministry of the Economy.

### **Norwegian Role in EUREKA Fieldbus Project Described**

92WS0325E Stockholm NEW SCANDINAVIAN TECHNOLOGY in English No 4, 1991 p 10

[Article: "A New Interface and Communications System"]

[Text] [Photo caption] In a Eureka project, a new fieldbus standard for the handling of information in process industry is being developed. Within this project and with support from British Petroleum, SI has made the physical layer for such a new standard. The system is called ISibus and is based on inductive couplers between the bus cable and the different sensors and actuators. ISibus transmits both signals and power, and systems in operation may be serviced even in zones with explosion hazards.

The aim of the Fieldbus Eureka project is to create a new interface and communications system between field-installed sensors/detectors and a control system as a replacement for conventional equipment in the 4-20 mA range.

Fieldbus, a multi-point serial line which can extend over a distance of about one kilometre within a process facility, will transmit information and measurements from a whole series of sensors and detectors to one and the same control and process unit.

By this means, highly worth-while savings can be made as regards the cables. Calculations on medium-sized oil drilling platforms with 4,000 measuring points indicate a possible reduction of around 90 percent, which is equivalent to 4 tonnes of copper.

The intention is for Fieldbus to be utilized in the first instance within the piece-producing industry and the process industry. These two application areas, however, make different demands of the system.

Within the process industry the bus is required to combine power storage and signal transmission on a single twisted pair of wires, a further requirement being that the system can be used in an explosion-hazardous

environment. When it comes to the piece-producing industry the distances are shorter, but at the same time higher data information transmission speeds are required.

#### Norwegian ISibus

ISibus is the Norwegian physical contribution to the Fieldbus project. The development work has been carried out in the Department for Industrial Metrology at the Centre for Industrial Research (SI) in Oslo.

The ISibus is a communication system for collection of data from transducers and/or Transmission of control signals to actuators in an industrial or hazardous environment, using only a single twisted pair of wires (trunk cable) for both communication and power supply of the field devices.

The ISibus is powered by a constant current AC power supply, connected to one end of the trunk cable. Both ends are terminated in the characteristic impedance of the cable. A field device is connected to the trunk cable with inductive couplers for both power and signals, mounted in one unit. This gives galvanic isolation and moreover the coupler unit can easily be clamped over the trunk cable for connection.

Connecting and disconnecting can be done without switching off the system or disturbing communications on the bus, even in hazardous environments.

An inductive coupler is electrically equivalent to a transformer. In the SI case, the two wires of the trunk cable that pass through the coupler core will represent a transformer winding of one turn.

Seen from the cable, each coupler therefore looks like a transformer winding of one turn inserted in series with the cable, or more correctly, two windings of a half turn in each of the wires of the cable. During transmission, the signal is therefore inserted as a constant voltage signal in series with the cable. This is in contrast to parallel insertion with more common conductive connections to the cable.

#### Field Tests

In order to study the ISibus concept in a realistic environment in terms of electrical noise and corrosive atmosphere, a small ISibus system was installed in December 1989 on the BP oil platform at the ULA field in the North Sea—250 metres of unshielded and 750 metres of shielded cable were used.

1,000 billion bits have been transmitted and checked over a period of three months. Ten bit errors have been detected.

The cable was routed in power cable trays and subsequently exposed to the most severe conditions. The test shows that the ISibus concept is highly suitable for communications in noisy industrial environments.

## DEFENSE R&D

### Matra, MBB, Aerospatiale Developing Supersonic Anti-Ship Missile, Reconnaissance System

92WS0276A Paris LE MONDE in French  
12-13 Jan 92 p 11

[Article: "Paris and Berlin Join in Launching Two New Armament Programs"]

[Text] France and Germany have signed two "protocoles d'accord" to undertake joint studies, on the one hand, of a surveillance system based on the use of reconnaissance planes, and on the other, of a supersonic anti-ship missile. Although the first of these agreements is, for France, subject to parliamentary enactment of the forthcoming military planning bill, the second is a definitively signed agreement. These agreements—they are what are known as *memorandums of understanding* or MOU's—were signed toward the end of last year, but their content was not disclosed until Thursday 9 January, by a source close to the French Defense Ministry.

The first of these memorandums goes back to the conceptual design of the surveillance system known as the Brevel system, based on lightweight planes and "stealth" drones, equipped with infrared cameras in the manner of American drones. These craft operate above the battlefield, over a zone measuring 50 kilometers on a side, and transmit their data to the ground, in real time, by means of telecommunications links protected from enemy jamming.

The Brevel system is a joint Franco-German design by the Matra group and the MSG company, a subsidiary of MBB [Messerschmitt-Bölkow-Blohm]. The cost of developing and industrializing the Brevel system has been put at 1.8 billion francs[Fr] for the two partners. The MOU signed officially on 19 December 1991, however, according to the DGA [General Delegation for Weapons], includes a suspensory clause to next April, allowing time for parliamentary passage of the 1993-1997 military planning bill, which the government is committed to introducing this spring. The second MOU, signed on 24 December, concerns the launching of the ANS [supersonic anti-ship] missile program as the successor to the Exocet, and is considered firm. Launched from a plane, a ship, or a coastal battery, the ANS missile's self-contained guidance system would enable it to strike a target at a distance of 200 kilometers. Estimated to cost around Fr2.5 billion, the development and industrialization of the ANS missile are to be financed by the two governments involved, France's Aerospatiale, and Germany's MBB, each at the rate of 25 percent of the total.



### **Germany Considering Rafale as Alternative to EFA**

92WS0276B Paris LE MONDE in French  
12-13 Jan 92 p 13

[Article: "Germany Expresses Renewed Interest in French Rafale"]

[Text] (AFP)—Seeking an alternative to its costly EFA [European Fighter Aircraft] project, the German Government is studying several possible approaches, and in particular that of the Rafale, to equipping the German Air Force round the beginning of the coming decade, according to German Defense Minister Gerhard Stoltenberg. Since 1988, Germany, Great Britain, Italy, and Spain have been developing the EFA (also known as the Eurofighter) project. Many quarters in Germany are opposed to building the plane, the total cost of which is estimated at some Fr180 billion for 250 units. The government has indicated that it will make its decision this year, but most experts across the Rhine consider the EFA a dead letter.

"We are again considering the French Rafale. We cannot discuss it from a military standpoint. The question is simply: Is it cheaper?" says Mr. Stoltenberg. "We are studying all options, barring none," the minister added. Germany, which inherited several Mig-29's after its unification, is studying, for example, the possible acquisition of American F-18's and Swedish JAS-Gripens, as well as the possibility of not replacing at all the Tornados with which the Luftwaffe is presently equipped.

### **France: Rafale Marine M01 Prototype Performance Reviewed**

92WS0325C Paris LE BULLETIN DU GIFAS  
in English No 1544, 19 Dec 91 pp 1-4

[Article: "The 'Rafale' Marine"]

[Text] The Rafale Marine M01 prototype, which is also the second development aircraft in the Rafale program, earmarked for the French Naval Air Force, made its maiden flight from Istres on 12 December. The pilot, Yves Kerherve, chief test pilot for Dassault Aviation flew the aircraft for one hour, and observed that all systems operated correctly. The speed of Mach 1.4 was reached at an altitude of 42,000 feet. This flight precedes contractual deadlines and indicates that all manufacturers involved are well in control of the program.

Although in the world of aviation, several military aircraft programs have encountered numerous technical problems and accumulated delays and, in some cases, crippling extra investment costs, the Rafale is delivering better than announced performance, and is ahead of deadlines and well within set budget. In other words, the program is right on the mark with regard to technique, deadlines and investments.

### **The Carrier-Based Version**

From the very outset, maximum common conception was sought between the air and marine versions. For this reason, the carrier-based version of the Rafale M will weigh only 750 kg more than the air version, in spite of the extra stress of this type operation. Weight difference will therefore be around 8 percent of empty weight.

Major differences of the marine version:

- Messier-Bugatti main landing gear adapted to added strain of deck landing and catapulting;
- Messier-Bugatti nose gear with energy return and catapult bar;
- Arrestor hook scaled to the stress of deck stops;
- Reinforced fuselage structure to withstand stress on landing gear and arrestor hook;
- Integral fold-down ladder for deck operations;
- A device for aligning navigation generators to those of the aircraft carrier;
- Deck-landing aids.

The air version will have the anti-corrosion protection of the marine version.

Common conception percentage between marine and air version is:

- 80 percent for structure;
- 90 percent for costs;
- over 95 percent for systems.

By the middle of 1992, the M01 will have completed and initial test series and move on to catapulting and deck landing tests on the ground in the United States, after which the first deck landings will be made on the Foch carrier in 1993. The lead-off Rafale Marine, or naval version, will be delivered to the Navy Air Force at the end of 1996.

### **Engine, Radar, Missile, Weapons and Electronics**

- Engine:

The eighteen SNECMA [National Aircraft Engine Research and Manufacturing Company] M88-2 engines built have already logged 2,600 hours of operation, 250 of which were in actual flight. One of the first M88-2's, to be used for endurance testing, is now on the test bed in Belgium at the premises of FN Moteurs, a subsidiary of SNECMA. It has already accumulated the equivalent of nearly 5,000 operational hours.

The SNECMA M88-2 is powerful, light and compact and will contribute much to the exceptional maneuverability of the production version of the Rafale, as specified by the Air Force and Navy.

- Radar:

The RBE 2 "2 plane electronic scan radar" is now being developed by a joint venture comprised of Thomson-CSF and Dassault Electronique. The prototypes for final development of this radar, Europe's first electronic scan

radar, will be tested in conjunction with Falcon 20's and Mirage 2000's. These test aircraft belong to the Flight Test Center, operated by DGA [General Delegation for Armaments]. The latter will handle the test program on behalf of GIE [Economic Interest Group] Radar, in close cooperation with Dassault Aviation, industrial architects of the Rafale program.

The RBE 2 will be adaptable to a wide variety of missions flown by the carrier:

- air-air missions requiring long distance detection, close combat, multi-target firing, very low altitude flight while avoiding ground obstacles and other threats;
- air-surface missions during which it will deliver the data needed for firing a complete selection of weapons;
- air-sea missions during which it will provide long range detection of targets for missile firing.

The new "expanded versatility" is based on the concept of simultaneous air-air and air-surface operation as related to modern air combat. The self-defense capability against interceptors without the need to interrupt low altitude flight will provide hitherto unmatched pilot safety during penetration flights.

#### • Missiles:

From the outset, the Mica, MATRA [Mechanics, Aviation and Traction Company] Defense's air-air interception missile, has been designed for exceptional operational adaptability in electronic warfare environment. This has been obtained by two electromagnetic homing devices, one of the active type and the other infrared. Consequently, this new generation missile with total combat and self-protection ability on both guide modes, will be the first in the world suitable for all air defense missions.

The Mica will be capable of long range (over 50 kilometers) multi-target interception, close combat and self-defense during tactical missions. It is an all-weather, all-sector missile and can be fired upward or downward while adapting to high amplitude snap-up and snap-down maneuvers.

Mid-life renovation has been designed-in to keep pace with development in the Rafale's navigation and attack system. New threats and technologies will be absorbable without modifying the basic structure.

#### • Payloads and Weaponry:

The navigation and attack system of the Rafale has been designed for the most modern available weapons with built-in provision for weapons to come. Weapons that can be used by the Rafale include:

- the Mica interception, combat and self-defense missile (up to 8 missiles);
- the laser-guided air-surface missile AS 30 L;
- the air-surface Apache fired from safety distance;

- the air-surface medium range nuclear missile ASMP;
- the supersonic anti-vessel missiles, ANS [Supersonic Anti-Ship], etc.

The aircraft will have 14 load attachment points (13 for the carrier-based version). This means that up to 8 tons of outboard load can be carried by the air version with extremely rapid and varied re-configuration capability because of aircraft-load interface standardization.

As internal weaponry, the Rafale M, B and C will have a new high firing rate 30 mm gun, the DEFA 791, built by GIAT Industries.

#### • Frontal Sector Optronics:

The Rafale carries a so-called "frontal optronic sector." This probe, integrated by SNA [Systems Network Architecture], gives the aircraft a long distance stealth detection capability for multi-target angular tracking and telemetry against air, sea or ground targets.

This equipment will be manufactured by Thomson-TRT Defense and SAT in cooperation.

#### • Countermeasures System:

The internal SPECTRA system ("System de Protection et d'Evitement des Conduites de Tir du Rafale") will confer exceptional survival ability against air-air and surface-air threats. It will detect, identify and localize these threats, enabling the pilot to take the appropriate action: electromagnetic jamming, infra-red decoy, maneuvers.

This electronic warfare system developed by Thomson-CSF, Dassault Electronique and MATRA defense and integrated at the SNA premises by Dassault Aviation will have built-in capacity for future developments to meet new threats.

With all these advantages, the Rafale will, under all weather conditions, be able to change weapon configuration in a very short time and execute a full line of missions which until now have each been handled by one specialized type fighter aircraft:

- ground or sea attack with the most recent weapons of the present and future;
- defense and air superiority;
- nuclear strike;
- reconnaissance.

The Rafale will be in-flight re-fueled and represents a formidable air power. Computation and simulation tests have shown that when equipped with a nuclear weapon and auxiliary tanks, the Rafale will have a better range than the Mirage IV P, the piloted strategic nuclear weapon, while being able to operate from shorter runways than the latter. This reinforces the deterrent capability of the nuclear forces.

The multi-mission, multi-purpose Rafale will replace seven different types of fighter aircraft in France (Mirage

III, Mirage 5, Mirage F1 and Jaguar in service with the Air Force; Crusader, Etendard IV P and Super Etendard with the Naval Air Force). The Rafale is a high-level technology program designed to enable the French air industry to maintain its knowhow and advanced position while supplying the French armed forces with the equipment it requires and offering a high performance product for export unrivalled in its category.

Key Dates		
Orders Placed for Development Aircraft:		
C01	Single-seat "Air" version	21 April 1988 (in testing)
M01	Single-seat "Marine" version	6 December 1988 (in testing)
B01	2-seat "Air" version	19 July 1989 (maiden flight in February 1993)
M02	Single-seat "Marine"	4 July 1990 (maiden flight around mid-93)

A special airframe for mechanical testing (CEM) ordered was delivered on 10 December 1991.

## ENERGY, ENVIRONMENT

### Belgium: Flemish Energy Technology Program Approved

92BR0174 Antwerp DE FINANCIËLE-  
EKONOMISCHE TIJD in Dutch 20 Dec 91 p 3

[Excerpts] Brussels—Yesterday, the Flemish Government gave the green light for the Energy Technology Impulse Program which was proposed some time ago by Minister of Economy De Batselier. [passage omitted]

The Flemish Energy Technology Impulse Program (VLIET) runs from 1992 to 1995 and is allocated a budget of 800 million Belgian francs (Bfr). The program focuses primarily on techniques to stimulate energy savings and the use of renewable forms of energy. There is a preference for techniques which are in the final stages and consequently can be put on the market rapidly.

A minimum of 15 percent (Bfr120 million) of the program budget will be spent on policy supporting research which focuses on technological aspects research (better known as technology assessment or the research into the social implications of new techniques). At least 25 percent (Bfr200 million) is reserved for renewable energy techniques.

The Institute for Scientific Technological Research in Industry (IWT) is in charge of carrying out the impulse program. The institute will also be responsible for selecting projects. Operational costs may not exceed 10 percent of the budget. The remainder is meant for financial support of projects which are expected to be put forward primarily by industry. [passage omitted]

### Berlin Promotes Block-Type Thermal Power Stations

92MI0218 Bonn DIE WELT in German 14 Jan 92 p 19

[Article by Richard Scheibel: "Heat, Light and Clean Air for the Capital—Funding for Block-Type Thermal Power Stations in Berlin"]

[Text] Berlin's Senate for Environmental Affairs is investing a total of 20 million German marks in a program to accelerate the construction of block-type thermal power stations in the city. These small power stations will provide industry, business, public bodies, and large apartment blocks with heat and electricity in an environment-friendly way.

By funding this recently launched project, Berlin's environmental authority is abandoning its previous opposition to block-type thermal power stations (BHKW's). According to Environment Senator Volker Hassemer, it is primarily the improved exhaust technology that has now rendered decentralized power supplies of this type viable in a number of districts.

BHKW's are small power stations powered by an internal combustion engine or a gas turbine. The power released by the unit is converted into electricity by a generator. The heat that arises as a by-product of oil or gas combustion is fed into heating plants or used to supply hot water. The pollutant content of the exhaust gas is reduced by the engine design or by catalytic converters.

It is felt in Berlin that this concept can be used to supply cheap, environment-friendly power in numerous locations, particular benefits being the considerable fuel savings compared with conventional supply systems, a design that tailors the plant to actual needs, and a substantial reduction in exhaust pollutants.

A total of 14 BHKW's are being funded, with construction scheduled for completion by 1993. The funds are drawn from an EC program that subsidizes up to 50 percent of investment costs.

The Berlin plants were selected for funding on the grounds of their particular suitability for decentralized power supplies. As the internal combustion engine can only produce electricity and heat simultaneously, the customer must also require both forms of power simultaneously; as a result, BHKW's cannot be used everywhere.

Hospitals are the classic example cited for effective decentralized power supplies. For this reason, one of the projects being funded is the new power plant at the Steglitz clinic, where a seven-megawatt block-type thermal power station can cover around 80 percent of the power requirements.

As this plant will both replace the old oil-fired boiler and provide the emergency electricity supply, the planners



expect fuel savings of around 41 percent, equivalent to around 620,000 liters of oil per annum.

Current estimates suggest that around 10 percent of the city's power requirements can be met by these small power stations; the environmental authority sees the greatest demand in the eastern part of the city.

This district already has numerous small-scale heating grids, though their heating plants are, without exception, in a very rundown state. Here, the transition to BHKW technology could bring not only the much-needed renovations, but also substantial economic benefits arising out of extra electricity generation.

Overall, the environmental authority expects the small power stations to have a substantial effect on pollutant emissions from power plants. From the example of the hospital-based BHKW, experts predict a 50 percent reduction in CO<sub>2</sub> emissions compared with the previous heating and electricity generating system, along with an 88 percent reduction for SO<sub>2</sub> and 15 percent for NO<sub>x</sub> emissions.

### German Government Sets Out Energy Policy

#### Overall Strategy Report Issued

92MI0247A Bonn *TECHNOLOGIE-NACHRICHTEN*  
MANAGEMENT-INFORMATIONEN in German  
17 Jan 92 pp 3-4

[Text] The coherent introduction of market economy controls is of the utmost importance in ensuring the rapid integration of the new federal laender into the national energy management scene. This emerges from the report on the federal government's overall energy strategy entitled "Energy Policy for the United Germany," according to which the new laender must abandon their total dependence on brown coal in favor of energy supplies distributed over a variety of sources. This will require improved legal investment security and a greater degree of privatization. The reclamation of polluted sites is a particular priority.

Regarding climate protection, the federal government states its main objective as reducing energy-linked carbon dioxide emissions, pointing to the need for an overall strategy on protecting the atmosphere, to be agreed across the broadest possible international base. Energy savings must take priority. To achieve the intended reduction in carbon dioxide by the year 2005, it is crucial to increase energy savings in buildings. Coal policy must take account of structural changes brought about by the EC's energy and subsidy policies, German unification, and the political transformation in the east. German hard and brown coal will still contribute to ensuring Germany's future energy supplies, though in smaller quantities than previously.

The federal government report "The Federal Government Overall Energy Strategy—Energy Policy for the United Germany" is published as Bundestag document

number 12/1799, and is available from the publishers, Verlag Dr. Hans Heger, P.O. Box 20 1363, Herderstrasse 56 5300 Bonn 2; Tel. 0228 363551; fax 0228 361275.

### Long-Distance Heating Promoted

92MI0247B Bonn *TECHNOLOGIE-NACHRICHTEN*  
MANAGEMENT-INFORMATIONEN in German  
17 Jan 92 pp 4-5

[Excerpts] A total of 300 million German marks [DM] are being provided for 1992 under the Long-Distance Heating Renovation Program, jointly conceived and financed by the federal government, the new laender, and Berlin, to renovate long-distance heat supply systems; this sum is expected to attract investments in excess of DM1 billion. The program is another element in the joint "Boost for the East" campaign and is intended to bring about the urgently needed renovation of long-distance heating. Moelleman, the minister responsible, sees the scheme, to be launched in 1992, as the start of a multiyear joint program.

The federal government has always stressed the importance of long-distance heating, and particularly of combined power and heat generation, for energy and environment policy reasons, its funding over many years in the older laender being evidence of its position in this respect. Long-distance heating from combined power and heat generation can also contribute significantly towards reducing CO<sub>2</sub> emissions, especially in the new laender.

The GDR's centralized planning of housing construction and its energy policy aim of self-sufficiency, have given long-distance heating far greater importance in the new laender than in the older ones: 24 percent of homes in the east are served by long-distance heating, 80 percent of which is produced from brown coal, though without adequate environmental safeguards. Both the production and distribution systems are seriously run-down, and measurement and control systems are lacking. In the past, long-distance heating received around DM3 billion per year, thus relying heavily on energy subsidies. Abolition of subsidies has meant that long-distance heating prices are now significantly higher than those in the older laender.

The present state of long-distance heating in the accession area calls for renovation and updating to the latest state of the art so as to give the system an economically viable, environment-compatible basis; state funding is needed to create a competitive long-distance heating system. The program will therefore support the maintenance of the long-distance heating infrastructure, which is worth renovating with a view to promoting rational power consumption and enhancing the environment. [passage omitted]

The program's resources will be used to renovate typical long-distance heating facilities, focusing on combined power and heat generation and domestic supply stations,

including the associated measurement and control systems. The funding also covers renovation of long-distance heating distribution systems. [passage omitted]

#### **Germany: Progress in Antipollution Efforts Reported**

92WS0254 Frankfurt/Main FRANKFURTER  
ZEITUNG/BLICK DURCH DIE WIRTSCHAFT  
in German 24 Dec 91 p 8

[Article by Dr. Christel Schuster, German Patent Office:  
"Emission Control: Progress in Reducing Nitrogen  
Oxide Emissions From Power Plants—Exotic Variation  
with Liquid Manure, Trends from Patent Applications"]

[Text] Munich—New antipollution laws or toughening already existing laws have always resulted in accelerated developments in the technology sectors affected. I would like to discuss three areas:

1. The Regulation Concerning Large Fuel Burning Plants which took effect in 1983 triggered an "ecological renewal program" with mandatory limits based on state-of-the-art technology. As a result, exemplary efforts were undertaken in the following years to equip the coal and oil fired power plants in the Federal Republic with leading-edge technologies for reducing the emission of nitrogen oxides and sulphur dioxide.

2. The amendment to the technical air regulation had a noticeable effect on the emission of solvents which are used in a great variety of industrial processes ranging from the surface treatment of materials to dry cleaning. This reduction in the emission of solvents is all the more important if we consider the fact that in 1982, for instance, more than 90 percent of the 1.845 million tons of solvents used were emitted into the air. This figure includes more than 20 percent halogenated hydrocarbons whose extremely slow photochemical breakdown leads to the formation of hydrogen chloride (hydrochloric acid) among other things.

3. And finally, in 1970 the European Community adopted emission limits for certain pollutants from vehicles for the first time. These limits were subsequently reduced in several steps and can now be met only by using a catalytic converter. In this field, current developments are aimed at reducing hydrocarbon emissions which are a major emission contributor in the cold start phase and account for more than 90 percent of a complete EC test cycle.

A few comments on item number one: Nearly 165 exhaust desulphurization lines with an exhaust throughput of 135 million cubic meters per hour were built. About 87 percent of these use a lime/limestone washing method with gypsum as a desulphurization product. Starting in 1990, approximately 3.3 million tons of this gypsum will be generated, and special concepts have been developed to find uses for this product.

Seven percent of the desulphurization plants are dry absorption or spray absorption installations which blow or spray  $\text{Ca}(\text{OH})_2$  or  $\text{CaCO}_3$  into the flue gas stream resulting in an end product which is a mixture of gypsum, calcium sulfite and other substances. The rest use various regeneration methods including adsorption to activated carbon or activated coke, where regeneration results in a sulphur dioxide rich gas which can be processed to yield sulphur or sulfuric acid as marketable end products. The latter method has the advantage that the regenerated adsorbates can be reused. Therefore, this method requires only a limited amount of waste dump space.

Progress was also made with measures towards reducing nitrogen oxides in the emission stream of power plants. Selective catalytic reduction with ammonia or compounds resulting in ammonia as a reducing agent is practically the only method used. The nitrogen oxides in the flue gas are converted at a temperature above 200°C and yield nitrogen and water. Previous developments concentrated on the chemical composition of the catalytically active metals and on the external form of the catalytic converters and their adaptation to the various methods. Depending on the fuel burning conditions the nitrogen can be removed at various locations in the flue gas stream—for instance immediately after the boiler (high dust version), after a high-temperature electrical filter (low dust version) or after the exhaust desulphurization (pure gas version). Consequently, the catalytic converters have to meet different requirements.

The high dust catalytic converters, usually in a honeycomb or plate shape, are susceptible to erosion because of the high percentage of dust in the gas stream. Therefore, they have to be particularly safe to withstand the blow-off process, and dust deposits have to be removed at regular intervals. If nitrogen is removed before desulphurization, only sulphur resistant catalytic converters can be used for coal and oil firing, for instance.

In addition to the honeycomb as a fixed-bed catalytic converter the circulating fluid-bed is also used for removing nitrogen from the flue gas through catalytic conversion. The gas stream fluidizes the catalytic converter removing and returning solids, with the nitrogen oxides being reduced on the surface of the catalytic converter in the presence of the reducing agent. The pellet-shaped catalytic converter consists of an abrasion resistant support medium with a catalytic layer.

Performance, selectivity and long-term stability of the catalytic converter depend on the synergistic interaction of support medium and the catalytically active components. Activated charcoal or activated coke have a catalytic effect and reduce nitrogen oxides up to 80 percent—usually in traveling beds—even at lower temperatures, i.e. slightly above 100°C.

The remnants of ammonia as the reducing agent in the cleaned exhaust cause a problem in all nitrogen removal methods. Therefore, recent developments have tried to

automate the addition of the reducing agent depending on the operating conditions as well as on nitrogen oxide conversion and to control it in such a way that there is no ammonia leakage.

At this point, I would like to mention an almost exotic version of a nitrogen removal method. Tests are being conducted which use liquid manure as a reducing agent instead of the expensive ammonia. Depending on the reaction set-up, considerable amounts of nitrogen can be removed with this method, and its use for cleaning flue gas (and these are still hopes) could at the same time solve a lot of other problems.

However, the inventive genius is already concentrating on the next group of pollutants which have made headlines in particular in connection with garbage incineration: the dibenzodioxines and dibenzofuranes or dioxins for short. The extreme variations in the composition of household garbage makes it almost impossible to control the incineration so that there is no dioxin formation during the incineration process or in the flue gas stream due to the catalytic effect of the filter dusts.

Therefore, the spectrum of applications ranges from methods to avoid the formation of highly condensed aromatic hydrocarbons by removing dust at ceramic filter elements and subsequent cooling of the filter dust under hermetically sealed conditions to the destruction by oxidation using known catalytic converters for nitrogen removal (now in the presence of oxygen) as well as adsorption to the "good, old" activated charcoal. The adsorption to activated charcoal still requires further processing to destroy the dioxins, such as heating in an inert gas atmosphere, which requires a lot of energy. (To Be Continued)

#### Environment Commissioner Comments on Audit

92WS0269D Brussels EUROPE in English  
21 Dec 91 p 8

[Article: "(EU) EC/Environment: Statements by Mr. Ripa di Meana on the Eco-Audit. The Seat of the Environmental Agency. Procedures Concerning the United Kingdom—Criticism of the Approach by Industrialists"]

[Text] Brussels, 20 Dec 91 (AGENCE EUROPE)—The European Commissioner charged with environmental affairs, Mr. Ripa di Meana, personally released to the press the Commission's proposal to the Council concerning the environmental audit (see yesterday's EUROPE, p. 9, and EUROPE of 30 November, p. 11, for the technical aspects).

He underlined the fact that the Commission felt it was necessary to retain for this initiative the form of regulation (compulsory in all its elements for all member states) in order to avoid competition distortion. If each member state did, in fact, have the capacity to define the provisions for granting the logo, conditions could be more or less stringent depending on the country and companies could be forced to choose the location where

the logo would be obtained more easily. Uniform EEC regulation is therefore indispensable. Mr. Ripa di Meana also pointed out that the small- and medium-sized firms will also find it advantageous to obtain the logo as the benefits (for their image, but not only this) will be concrete and the cost minimum (ECU3,000 every three years, for a site of modest dimensions). If the project is adopted, the Commissioner feels there could be a new philosophy of industrial production as a result. Mr. Ripa di Meana nevertheless spoke harshly as regards industry, which is generous in promises and declarations of principle but, for concrete action, often opposed to operational initiatives. "Unfortunately I have always met with the opposition of powerful lobbies acting even within the Berlaymont, whether it be for the catalytic exhaust pipe, diesel fuel norms, impact studies related to major agricultural projects or, more recently, for the proposal of a tax on CO<sub>2</sub>—and now the eco-audit", he stated.

The Commissioner also gave indications on:

a) The seat of the European Environmental Agency (EEA). Next month Mr. Ripa di Meana will ask the Commission to put the proposal to the Twelve for the Agency to have "the seat in turn" as a temporary solution, each half-year being in the capital of the presiding Council. The seat would therefore be Lisbon for the first half of 1992, London during the second half, and so on. It would no doubt be an "irrational and far from perfect" solution but it would make it possible to overcome the current total deadlock and to concretise the birth of EEA. Failing this, the Community would find itself in a more than embarrassing situation at the Rio Conference in June. With this initiative, the Commission would be reacting to a "cynical refusal" on the part of France and Belgium by allowing the seat to be designated and the EEA to exist. It would be all the better if this initiative could unblock the situation and reach a final decision, which would only be good sense.

b) Infringement proceedings opened against the United Kingdom for non-respect of the EEC 1985 Directive which made "environmental impact studies" compulsory for major public or private works (see EUROPE of 18 October, p. 8). Mr. Ripa di Meana was astonished to have read indications of Mr. Heseltine's response in the British press—long before receiving the letter. The letter has now arrived and will be carefully studied. The Commissioner cannot make any predictions as to the result of the legal analysis as regards the reasons for which the United Kingdom feels there is no infringement on its part of Community legislation. Nevertheless, he regrets that the British Government has not followed up his "political appeal" to suspend the work in question (which has not been preceded by the preliminary impact study) pending the results of proceedings. EUROPE recalls that these are major projects such as enhancement of the Thames bank, the rail connection between London and the Channel Tunnel, an incinerator for the South Warwick hospital, the Coca-Cola/Schweppes factory in Northampton, etc.



Moreover, Mr. Ripa di Meana confirmed his intention of submitting to the Commission, in January 1992, a project for the fifth EEC programme for the environment, which will be valid for ten years and will be "revolutionary" to a certain extent. He hopes the Commission will submit it to the Council in the first half of the year, under the Portuguese presidency, and that the Council approve it in the second half, under the British presidency. The main guidelines have already been defined by the Commission's services, but there remain some fundamental policy options, for example, whether it is possible to envisage the creation of a Community corps of inspectors for the environment.

### **EC To Finance THERMIE Clean Electricity Production Technology Project**

92WS0269H Brussels EUROPE in English  
6 Dec 91 p 10

[Article: "(EU) EC/Energy: The European Commission Announces It Will Finance Technology for Electricity Production That Reduces CO<sub>2</sub> Emissions by 20 Percent. Within the Framework of the THERMIE Programme"]

[Text] Brussels, 05 Dec 91 (AGENCE EUROPE)—The European Commission announces that it has decided to finance a project for the development of electricity production technology able to reduce CO<sub>2</sub> emissions by 20 percent as compared with traditional coal power plants.

Financing comes under the THERMIE programme (European technologies for energy management) and concerns the design, construction and demonstration of an electricity production unit fueled by gasified coal through the idea of combined cycles (IGCC—Integrated Gasification Combined Cycle). The project will be developed in collaboration with six EC electricity enterprises. It will benefit from a first tranche of MECU15, from Community financing.

IGCC technology is currently considered as representing future electricity production from coal, as it makes it possible to drastically reduce polluting CO<sub>2</sub> emissions as well as sulphur dioxide and nitrogen oxide. Further to the Council's request (THERMIE regulation) to organise European cooperation around a major transnational project using this technology, the Commission has taken this decision which is the first concerning a "targeted" project in the framework of the "THERMIE" programme.

The project will be implemented by four Spanish electricity companies (ENDESA, Hidroeléctrica Española, Sevillana de Electricidade, Hidroeléctrica del Cantabrico), by Electricite de France and Electricidade de Portugal, on the Puertollano site in the centre-south of Spain. Other electricity companies have already informed the Commission that they wish to join in this first Community attempt at collaboration in thermoelectric production.

During the demonstration period, a large range of coals (EC and international) will be tested. After this period,

the IGCC power plant will operate with bituminous coal produced in the open-skies mine in Puertollano. Emissions of SO<sub>2</sub> (sulphur dioxide) and NO<sub>x</sub> (nitrogen oxide) will be, respectively, 40 and 11 times less than limits laid down in the Community directive on emissions from electricity power plants.

### **European Car Recycling Concept Launched**

92WS0269I Brussels EUROPE in English  
18 Dec 91 p 16

[Article: "(EU) EC/Environment: European Automobile Industry Initiates European Car Recycling Concept"]

[Text] Brussels, 17 Dec 91 (AGENCE EUROPE)—The ACEA, the Association of European Automobile Manufacturers, has initiated a European car recycling concept in order to minimise any adverse environmental impact from the disposal of cars at the end of their useful life. The ACEA presents the concept below in the form of a commitment:

- 1) The European automobile industry accepts its responsibilities regarding the management of vehicle disposal. It shares some of these responsibilities with the vehicle owner.
- 2) The appropriate supplying industries concerned share responsibility for the processing or recycling of their products.
- 3) Automobile manufacturers are already taking major steps to avoid and reduce residual material (by modifying vehicle design specifications) to reduce the variety of materials used and increase the possibility for the reprocessing and recycling of components and materials.
- 4) National authorities should promote the operation of processing facilities, meeting European regulations to deal with remaining shredder residues.
- 5) The introduction of a mandatory "Certificate of Disposal" is needed, which the last vehicle owner has to obtain before he can dispose of his vehicle and be relieved from tax/insurance obligations. The "Certificate of Disposal" would be issued by an authorised qualified operator. This procedure would ensure the avoidance of uncontrolled dumping of the unwanted vehicle; that only qualified operators fulfilling existing or future legal requirements would collect, dismantle, sort and process vehicles for disposal; and the granting of motor vehicle industry technical assistance to qualified operators. There is a need for a widespread, flexible network of qualified operators in Europe. Only competent operators should become authorised to process vehicles for disposal. The proposed concept is strictly market-orientated. The qualified operator should operate according to market prices. In the future, this may result in a payment to a vehicle owner at the moment of disposal due to the intrinsic value of the material. The

more "recyclable" a vehicle is, the higher the value may be. For incomplete vehicles or vehicles difficult to recycle, the owner may have to pay for disposal. This is viewed as an encouragement for automobile manufacturers to work harder to design easy-to-recycle automobiles as well as to establish recycling chains.

### **European Car Manufacturers To Reduce CO<sub>2</sub> Emissions**

92WS0269J Brussels EUROPE in English  
13 Dec 91 p 15

[Article: "(EU) Environment: European Automobile Manufacturers Volunteer To Reduce CO<sub>2</sub> Emissions by 10 Percent by 2005"]

[Text] Brussels, 12 Dec 91 (AGENCE EUROPE)—European passenger car manufacturers grouped in ACEA (Association des constructeurs européens d'automobiles), the newly established manufacturers' association, have volunteered to reduce CO<sub>2</sub> emissions of their cars by 10 percent within the period 1993 to 2005, thereby bringing their support to the objective the EC has set itself of stabilising these emissions at their 1990 level. The ACEA recalls that total road transport's contribution to man-made CO<sub>2</sub> emissions is less than 14 percent worldwide and 19 percent in the EC (15 percent for passenger cars). Moreover, according to the Association, the manufacturers have managed to reduce average fuel consumption by more than 20 percent since 1978. They note that improvements can still be achieved if other methods are adopted in other fields relating to road traffic, such as: a) traffic management; b) development of alternative fuels and c) adapting appropriate driving methods.

According to the ACEA, this commitment should be supplemented by a new, global and integrated European approach to reduce CO<sub>2</sub> emissions, which should be part of a balanced worldwide programme directed at sources of CO<sub>2</sub>/greenhouse gases. If a carbon tax on energy is part of this programme, the automobile industry emphasises the need to offset this additional burden on the automobile consumer by a reduction of the heavy taxes paid when buying or using automobile products. Should such measures affect the European industry exclusively, ACEA stresses that this would create a competitive disadvantage vis-a-vis other industrial regions which are not prepared to take similar steps, notably North America and Japan.

### **France: Government Agency To Maintain Inventory of Radioactive Waste Management Sites**

92WS0286C Paris LE MONDE in French  
18 Jan 92 p 18

[Text] ANDRA [National Agency for Radioactive Waste Management] will be undertaking a nationwide inventory of sites in which radioactive waste is stored, its director, Henri-Edme Wallard, indicated on Tuesday 14 January. He said that this task has now been made one of

ANDRA's missions as defined by the 30 December law on radioactive-waste management research.

This law, stemming from proposals by the Parliamentary Office of Scientific and Technological Choice Evaluation, and published in the 1 January issue of JOURNAL OFFICIEL, was passed by a very large majority of the National Assembly and the Senate (LE MONDE of 29 June and 8 November 1991). In accordance with the Office's recommendations, the law modifies ANDRA's statutes radically, detaching it from the CEA [Atomic Energy Commission] as an "industrial and commercial public establishment" [EPIC] in its own right, and placing it under the supervision of the Ministries of Industry, Research, and Environment.

This law assigns to ANDRA, in addition to its traditional missions, that of "listing the state and location of all radioactive waste found in the national territory." All waste-disposal sites are included, those containing low-level radioactive waste, such as, the CEA waste-disposal sites at Bouchet and at Saint-Aubin (Essonne) and the former uranium mines at Limousin, as well as EDF [French Electric Power Company] and COGEMA [General Nuclear Materials Company] installations where spent fuels and highly radioactive reprocessing residues are dumped.

That does not mean that ANDRA will take charge of sites that are not presently under its responsibility, Mr. Henri-Edme Wallard pointed out. Its task is solely to draw up an inventory based on available documents and reports on these sites. Thus, ANDRA's role will be solely that of "collector and retransmitter of information." It will centralize all the data so that all interested persons may have access to "the means of forming a global view of the problem."

Paralleling these new responsibilities, ANDRA will continue carrying out the missions that have traditionally been assigned to it since its creation in 1979. The law has confirmed its active role in studies and research aimed at defining, by 2010 at the earliest, the form of management of long-life and highly radioactive wastes currently being dumped temporarily at their respective production sites.

The management of disposal sites for short-life, slightly and mildly radioactive waste remains, of course, in its province. In this regard, the Aube disposal center received, on Monday 13 January, its first "parcel" of waste: A truckload of 28 barrels, 24 of which came from the EDF nuclear plant at Bugey dans l'Ain.

This waste-disposal center is located at Soulaines, approximately 50 km east of Troyes, and is designed to receive, between now and the year 2025, a total of 1,000,000 cubic meters of slightly and mildly radioactive waste (LE MONDE 10 October 1991). This "cemetery" is designed to last for three centuries, the time needed for the radioactivity of the products it holds to be divided by a factor of 1,000. It will gradually take over the functions

of the Manche center, which is presently operated by ANDRA near Hague, and which is slated for closing by 1994.

### France to Study Aircraft's Effect on Atmosphere

92WS0298A Paris AFP SCIENCES in French  
12 Dec 91 pp 11, 12

[Article entitled: "Government Creates 'Airplane-Ozone' Committee to Study the Effects of Air Transportation on the Ozone Layer"]

[Text] To buttress the multidisciplinary research being done around the world on the destruction of the ozone layer, the French Government announced on 24 December that it was creating an Airplane-Ozone Committee to investigate the effect of air transportation on stratospheric ozone. The committee's work should serve to "furnish the scientific and technical data needed to draft an international set of regulations" and to expand scientific exchanges with other countries.

The Ministry of Equipment, Housing, Transportation and Space, the Ministry of Research and Technology, and the Ministry of the Environment took it upon themselves to create the committee. According to their joint communique, the Airplane-Ozone Committee will have an average budget of 5 million French francs [Fr] over a four-year period that will begin in 1992.

The committee will be made up of 15 members and will be presided over by Mr. Jean Carpentier, a high-ranking scientific advisor to the National Office of Aerospace Studies and Research (ONERA).

There is a growing interest around the world in the impact of air flight on the atmosphere, and in particular on the atmospheric and stratospheric ozone. A great deal is at stake, both in terms of protecting the environment—the ozone filters ultraviolet waves—and safeguarding the aerospace industry.

Because of the criticism that was directed against the Concorde, France created a Committee for Stratospheric Flight (COVOS) 20 years ago. COVOS's work furthered scientific knowledge of the atmospheric ozone at that time. "What is needed now is to synthesize the research that has been done and give it the scope needed to expand air transportation without neglecting environmental imperatives," stresses the communique.

The bottom of the stratospheric ozone layer comprises the air space between 10 and 25 kilometers of altitude. The number of flights there is increasing, since most transoceanic flights are made at around 10,000 meters, and the number of space flights is also expected to rise. The Airplane-Ozone Committee will therefore focus on the effect of gases released into the stratospheric ozone layer, which is already under attack by other emissions of human origin.

Individuals who are recognized as specialists by the scientific community, the aeronautics industry, and government authorities will sit on the committee. An inter-ministry commission headed by the civil-aeronautics programs administration will monitor the committee's work and distribute budget monies.

The Research and Environmental Ministries are already participating in research on the upper atmosphere through the "Middle Atmosphere" and "Atmospheric Phase of Biogeochemical Cycles" programs. The programs are being conducted by the CNRS (National Center for Scientific Research) and the CNES (National Center for Space Studies).

### Biomass Experiments in Eastern Germany

92WS0335A Munich SUEDEUTSCHE ZEITUNG  
in German 9 Jan 92 p 40

[Article by Christa Friedl: "China Reeds Instead of Brown Coal"]

[Text] At first glance the plant is quite inconspicuous. The knee-high tufts barely rustle in the cold wind, withered plant parts cover the swampy ground, freezing December nights have left dead spots on the thumb-wide leaves. Georg Vogel sees it quite differently however. The Director of the Central Research Institute in Grossbeeren near Potsdam surveys the hundred-meter-long reed-covered field and remarks: "The *Miscanthus* you see here is just six months old. What other plant in the world grows so fast?" Indeed, the reeds produce 15-times more biomass per surface unit than an average forest.

The Institute's director, Georg Vogel, wants to harvest in a few months. That which is now shining in small tufts in the eastern German sun represents for many the energy source of the future. "By using *Miscanthus*, the green house effect could be contained," Wolfgang Staender, a Munich resident, who is much involved in promoting the elephant or China reeds, believes. Were oil, gas, and coal to be replaced by a rapidly growing biomass, then, in the opinion of the Munich scientist, a power source would be assured to all of mankind. When plants are burned for power, they can only release back into the atmosphere as much climate-affecting carbon dioxide (CO<sub>2</sub>) as they took in from the air and converted to biomass during their growth period.

China reed, *Miscanthus sinensis*, belongs to the so-called renewable raw materials like rape, flax, or exotic pharmaceutical plants. What these plants have in common is that they deliver fresh from the field a basic material for the extraction of a particular raw material. From flax, for example, fiber and linseed oil has been extracted since antiquity; from rape, a substitute diesel fuel; from pharmaceutical plants, valuable substances for medicines. China reeds play a special role among the renewable raw materials. Their hollow stalks, after they have been ground to a powder and burned in a power plant, produces electrical current and heat.



### Approval to Cultivate

Unfortunately, renewable raw materials do not attract much interest. According to the German Ministry of Research and Technology (BMFT), only 46,000 hectares in Germany are presently given over to renewable raw materials. For years, even *Miscanthus* has been grown in only a few niches. But now Bonn has promised financial aid to grow China reeds. BMFT will assign DM30 million through 1994 to smooth the way for the reeds to enter the power plants.

In this regard, experts estimate that by the end of this century Germany will be able to dispense with 4 million hectares of cultivated land currently used for food production. And in the five new laender (states) there is already superfluous farm acreage, the soil of which often loaded with harmful substances. This acreage provides a golden opportunity to grow renewable raw materials. Under the care of the former GDR Central Research Institute for Vegetable Production, *Miscanthus* is to be grown on a total of 100 hectares in 12 sites in the Potsdam, Cottbus, and Frankfurt/Oder districts. The indestructible reeds not only grow rapidly, but also in highly contaminated soils. "For example, for decades eastern Berlin's drainage water was washing about in Grossbeeren," Georg Vogel recalls. Soil analyses today present the bill for this so-called "waste management." More than 300 milligrams of copper, 250 milligrams of lead, and 30 milligrams of cadmium per kilogram of soil.

Nevertheless, there is no reason for any great optimism. "We have to do far more to make the use of such fuels economical," Heinz Riesenhuber, the federal minister of research recently warned during a visit to Grossbeeren. There is still insufficient precise knowledge about the cultivation, harvesting, processing, and use of *Miscanthus*. "First, for example, we have to find out how much of the heavy metals in the soil actually enter the plants, Juergen Roemer-Maehler, director of BMFT's renewable raw materials section, explained. These heavy metals are again activated during the cultivation of the reeds and in the end are found in the ashes and smoke after the reeds are burnt. Questions dealing with the most suitable varieties of *Miscanthus*, about fertilizers, pesticides, and water requirements are still not resolved.

But the lack of knowledge about the reed and the meager funding (at least in the past) to support its cultivation are not the only obstacles that have held *Miscanthus* to such a limited acreage. "It is urgent that outstanding questions as to the plant's possible applications first be clarified," the BMFT recommended in a just released interim report entitled "Renewable Raw Materials." Only when the use of plants as energy sources is fully understood will their cultivation be worthwhile.

The hurdles to be overcome in the energy market have been set quite high. A prime prerequisite for the use of reeds as a fuel is the establishment of a decentralized energy supply system, since the cultivation, harvesting,

processing and burning can only be organized economically on a regional basis. Yet the chances of accomplishing this have been considerably spoiled by the energy agreements concluded between the eastern German communes and the three large western energy suppliers (EVU) in 1991.

At the same time, the BMFT interim report cites good reasons for the establishment of a decentralized structure in eastern Germany. Unlike the situation in the old Federal States in the west, heat networks in the east, capable of carrying economical energy from smaller power plants, are widely distributed. In addition, there are numerous smaller power plants in the ex-GDR, with outputs of between one and 40 megawatts that could easily be converted to biomass. By 1994, the BMFT wants to acquire four to six pilot power plants, each with an output between one and 40 megawatts, in which *Miscanthus* would be burned as fuel.

Western power companies do not think much about the green fuel. In the energy market, renewable energy sources will be of no significance even in the mid term, according to Fritz Peters of the Technical Union of Major Power Plant Operators in Essen. Exceptions confirm the rule however. *Miscanthus* has been well known in the Schwaben Power Supply (EVS) in Stuttgart since 1987. The growth potential of the reed has been tested in long-term experiments in small parcels of land. The results were sobering. To be sure, *Miscanthus* grew amazingly well in Swabian soil. The Stuttgart researchers achieved harvests of between 30 and 40 tons dry mass per hectare. However, the EVS Central Office in Stuttgart went on to say that "in order to be able to compete with conventional primary energy sources, the yield per hectare would have to be in excess of 70 tons." Moreover, *Miscanthus* would only pay if the present cost of imported coal were to double, and the costs for the plants were to sink drastically. Consequently, EVS has no specific plans to use *Miscanthus* or any other renewable fuel in any of its existing power plants.

The final decision as to the future of *Miscanthus sinensis* will possibly be made at another level. One hundred and sixty three eastern German communes have filed a complaint against the monopoly of the three major energy suppliers RWE in Essen, PreussenElektra in Hannover, and Bayernwerk in Munich. Should the communes win the case, a more decentralized power supply system can be expected in the new states. "We hope so," says Felix Zimmermann, the business director in the Cologne Association of Communal Enterprises. However, he does not expect a decision to be handed down before next summer.

To be sure, renewable fuels do not have a chance in the old Federal States in the West. BMFT expert Roemer-Maehler puts it this way: "The EVU monopolies in the West are not about to be broken up."

## Factory Automation, Robotics

### EC: Progress of CIM Open Systems Project Noted

92BR0048 Zellik *INDUSTRIE* in Dutch  
Nov 91 pp 11, 13

[Article signed L.V.: "Manufacturers Learn To Think Conceptually...Through CIM-OSA [Computer-Integrated Manufacturing/Open Systems Architecture]"]

[Text] Last month, the first results of the CIM-OSA [Computer-Integrated Manufacturing/Open Systems Architecture] project, which was initiated by the AMICE consortium within the scope of the European Strategic Program for R&D in Information Technologies (ESPRIT), were made public. This research group consists of some 22 users, universities, software houses, and consultants dealing with computer-aided technologies. The purpose is to develop an open systems architecture for computer-integrated manufacturing. The 22 participants include two companies established in Brussels: Alcatel with its Advanced Manufacturing Center at Zaventem, and Cap Gemini Sesa Belgium. The participation of MBLE [Belgian Lamps and Electronics Manufacturer] was earlier canceled by Philips.

Researcher Dirk Beeckman of Cap Gemini Innovation: "CIM-OSA was started in 1985 within the framework of ESPRIT. The EC Commission felt that a CIM architecture could only be successfully standardized through a large-scale project, which explains the 20 participants." In addition to a number of large users such as Daiat, British Aerospace, AT&T, and Aerospatiale, the participants also include a number of hardware and software companies such as Digital, Siemens, IBM, and HP. So CIM-OSA's European label is rather questionable. Some elements of the CIM architecture proposed by newcomer IBM at the end of 1989 were indeed taken over. Which is bad luck for Digital, which had been in the running for much longer and is more committed to its "historic reality." Nevertheless, a first standard—the Frame of Enterprise—was approved in 1990. This standard must now be implemented. It has already been submitted to the International Standards Organization (ISO), where discussions are, however, progressing much less smoothly. The imminent agreement for more extensive cooperation between the EC Commission's DG-XIII [Telecommunications, Information Industries, Innovation] and the U.S. Department of Defense—which practically monopolizes research activities in the United States—will probably also result in cooperation between CIM-OSA and its U.S. counterpart, the Enterprise Integration Project. For Cap Gemini, which is increasingly involved with systems integration, an industrial project such as CIM-OSA is very interesting. The contribution of Cap Gemini Innovation's research department will consist mainly in validating the proposed solutions at the premises of final users such as Fiat and Aerospatiale. Dirk Beeckman: "As software developers, we are used to working with models. Based on a functional analysis, we

draw up conceptual specifications resulting in an executable code. In our sector, this is a generally accepted method, which allows us to deal with problems in a conceptual way. But, much to my surprise, this approach finds less acceptance in industrial environments. This is what the CIM-OSA project intends to change."

CIM-OSA consists of two parts. The first part, the "Framework for Enterprise Modeling," is made up of various elements: (1) a description of the objective of final users, the so-called requirement modeling; (2) the design with the technical specifications; and (3) the final implementation. At present, these three elements are intertwined. But all too often, the present models do not fully meet the customers' requirements. At the design level, too much use is made of simulations to forecast the possible result and as a means to influence the implementation.

Dirk Beeckman: "At Cap Gemini, we are now emphasizing requirement modeling. Once the simulations at the design level have been completed, we build an implementation-oriented model. This is, for instance, a description of the different machine operations which allow us to control an environment's cycle time. Subsequently, all aspects, such as functions, information, and research, must be integrated. We aim at standardizing the different components of the models, so that they can be reused later."

The second part of CIM-OSA is the "Integrated Infrastructure," which is in fact an extensive communications platform intended to keep track of and route information and to avoid duplication. For the efficient circulation of information, the interfacing toward the different knowledge fields is also important. The aim of CIM-OSA is to integrate ongoing efforts in all these specific sub-problems. At present, the discussion focuses mainly on the acceptance of certain existing substandards for such specific solutions. The OSI structure, and in particular layer seven, is given a great deal of attention. There is a good chance, for instance, that the Manufacturing Message Specification may become the standard for all computerized numerical control (CNC) machines.

### Swiss National Research Program on Applied Artificial Intelligence

92WS0170A Zurich *NEUE ZUERCHER ZEITUNG*  
(INTERNATIONAL EDITION) in German  
27 Nov 91 p 49

[Article by Dr. Hans Peter Eggenberger: "Robots Need More Flexible Reactions: Importance of National Research Program NFP 23"]

[Text] Countless modern machines and systems are equipped with microprocessors that automatically control and monitor costly work procedures. To achieve this, precise structuring, which permits the procedure (computer program) to be unambiguously and formally broken down in a series of rules and steps, is an absolute prerequisite. The same prerequisite is also required for

most modern robot systems. For example, robot systems cannot cope when a workpiece or an assembly part is not in the correct position or in the proper place, when a component is defective, or when a foreign object is obstructing the flow. It is now believed that artificial intelligence can significantly improve the operation of such systems. The term "artificial intelligence" is used for computer programs by means of which complex data can be processed and the correct conclusions drawn. The "intelligence" resides especially in the interaction of diverse partial systems and in the optimal handling of large amounts of data—very often in real time. Certain complicated tasks can only be solved by means of artificial intelligence. It is believed, for example, that advantages derived through artificial intelligence will especially be seen in industrial manufacturing, but in many other fields as well. It is further hoped that artificial intelligence will help in better understanding the cognitive processes taking place in the human brain and in replicating it in the simplest form.

#### Research in Robotics

In Switzerland limited artificial intelligence projects are currently being pursued in various universities using general confederation research funds. National Research Program (NFP) 23, which has been allocated 12 million Swiss francs through 1994, is the first comprehensive program. As compared with the State-supported projects in other industrialized countries, the Swiss effort appears modest. The objective of NFP 23 is not pure basic research, but the investigation, development, and application of artificial intelligence methods and tools, taking into account the broad spectrum of applications, particularly with respect to robotics.

Another important goal is the training of engineers and specialists, who will master the advanced techniques of data processing. It will be their task to convert the knowledge gained in the research institutes into industrial and economic assets.

NFP 23 is directed by Professor Walter Schaufelberger of the Swiss Technical University of Zurich (ETHZ). A team of experts, presided over by Professor Olaf Kuebler (ETHZ), has selected the 15 most promising projects from among those submitted. Investigations in the fields of image processing, robotics, and neuronal systems were favored. Mostly involved in these projects were university research groups, which cooperate in various projects throughout the country.

If human sight and recognition faculties are to be replaced by a machine, one soon realizes how limited the technical capabilities now available really are. The eyes and the brain form a system that functions in a marvelous manner. When attempts are made to replicate this system, its complexity becomes immediately apparent. Without any particular assistance, a human very rapidly identifies numerous characteristics of a newly viewed object, i.e., information about its size, form, color,

composition of the material, motion, and so on. Immediately, associations are made in the brain with respect to similar objects.

It is still beyond today's capabilities to create a comprehensive, artificial replica by means of models. Before a machine recognition capability can be developed, the recognition process itself must first be broken down into small steps and limited to relevant characteristics. They can differ in each application.

#### From Image Processing to Neuronal Systems

Nevertheless, there are versatile methods and tools available that can be put to the task. NFP 23-supported projects concentrate on just such methods and tools. They include investigations dealing with the optimal location of the observing cameras, and various methods and steps in the recognition of objects and their composition. Three-dimensional objects as well as certain moving bodies are also under study. The calculating capability required in these investigations is extremely high and demand special computer architectures.

Image processing is an important component of robotics. The recognition of individual objects and their environment is one of the essential problems in the use of robots. There are two projects in NFP 23 that are devoted to specific robotics problems. The first project is studying the behavior of a "general" assembly robot for the assembly of devices and systems that take errors and tolerances into account, while the second project is investigating the behavior of a mobile robot in an unfamiliar environment.

Neuronal systems constitute some of the most advanced tools in artificial intelligence. The manner in which they function and the principles on which their construction is based are borrowed from neurobiology. An important characteristic of these concomitantly operating systems is their ability to learn. By means of examples, the neuronal system programs itself for a specific task, for the execution of which a single instruction, the learning rule, need be entered. But the manner in which neuronal systems function still presents many unanswered questions. Two NFP 23 projects are given over to these questions. The first project undertakes comparisons with classical methods of data processing, while the second method searches out and tests typical industrial fields of application for the neuronal systems.

But artificial intelligence is also valuable in quite different fields as, for example, in psychology, where neuronal systems are used to investigate human learning processes. Other fields are, for example, the automatic classification of documents or advanced tasks in computer aided design (CAD) and computer-supported learning. The half-way point in this program was recently reached. Results have already been made available for further research. Even though it is evident that these results do not represent any specific applications, the



program management is interested in testing the first steps with potential users in industry and the service sector.

### **France: High-Speed Machining Program Launched**

92WS0172C Paris L'USINE NOUVELLE in French  
14 Nov 91 pp 78, 79

[Article by Stephane Farhi: "Very-High-Speed Machining Gaining Ground: 3-Year Research Program Launched"; first paragraph is L'USINE NOUVELLE introduction]

[Text] A three-year research program, and new applications centered on hard materials: French industry is banking on TGV [very-high-speed [VHS]] machining.

The big French industries believe in the future of machining metals at very high speeds, which they are testing. Gathered together for the past two years as members of the AUTGV [Very-High-Speed Machining Association], PSA [Peugeot Corporation], Renault, Dassault, Aerospatiale, Snecma, and Ascometal are seeking to extend the range of applications of this technology, which is currently being used mainly for the machining of light-weight alloys and cast iron, into the realm of hard metals (alloy and heat-resistant steels, titanium, superalloys).

Concurrently, they are launching a three-year research program together with three manufacturers of machine tools and broaches (Renault Automation, Brisard, and Precise), three universities (Metz, Toulon, and the ENSM [National Higher School of Mechanical Engineering] at Nantes), and CETIM [Mechanical Industries Technical Center]. The project is funded in the amount of 25 million francs[Fr], 50 percent of which is contributed by the Research Ministry under its "technological leapfrogging" program, and is centered on the milling and boring of hard materials.

"Very-high-speed machining is gaining ground in France," says Joel Vigneau, head of this area of activity at Snecma. Following in the footsteps of aeronautics, the automobile and mechanical industries are gearing up to use this technique on a large scale. Since its introduction as a technological innovation around the beginning of the 1980's, VHS machining has become, over the past two to three years, an industrial goal. Its development has been made possible by the concomitant advent of high-speed (10,000 to 60,000 and more rpm) electrodrills, ceramic tools, and 32-bit fast numerical controls, as well as by the advances made in materials suitable for machining. But beyond the gains it has brought in high-performance cutting, VHS machining is going to profoundly change the design of machines and the organization of workshops.

From the standpoint of performance, VHS machining techniques enable cutting speeds and/or drill rotation speeds five to 10 times higher, for a given material, than conventional speeds. Snecma turns turbine discs made

of Inconel (a nickel-based superalloy) on high-speed lathes at its Creusot flexible workshop. The ceramic tools used (alumina alloyed with titanium carbide or silicon carbide, silicon nitride) enable the use of cutting speeds (200 to 300 meters/minute) 10 times higher than those attainable with conventional carbides (25 m/min). Their useful life is only five to eight minutes, versus 15 to 20 minutes for carbides, but their chip-removal rates are five times higher. Gains in processing times range between 30 and 80 percent, and gains in cost around 20 percent owing to the high price of ceramic tools (five or six times higher than for carbide tools).

For the past two years, Snecma has been studying the possibility of milling this material by surface grinding. A cutting speed of 1,400 m/min has been attained by reducing the life of the tool to one minute. But this time lapse is sufficient to remove five times as much chip as in 30 minutes of conventional surface grinding! Snecma is planning, however, to operate industrially at cutting speeds between 600 and 800 m/min. Preparations in this regard are already under way.

In any case, the developmental work being done by Snecma indicates a VHS-machining trend toward hard materials. To date, a sizable number of applications have concerned lightweight alloys, such as those based on aluminum, which are easier to work. From this standpoint, the big user has been the aeronautical industry. Dassault at its Seclin plant, and Aerospatiale at Nantes, use high-speed millers to machine large components made of aluminum alloys. In February 1991, Aerospatiale's Engine Division put in operation at Chatillon a five-axis VHS machining center (15 kW of power for a turning speed of 12,000 rpm) to produce mechanical components made of aluminum and large-sized components (2 meters) cut from the block.

But attention is centered now on hard materials. Snecma, Dassault, and Aerospatiale have teamed up for a joint study on the machining of titanium alloys and heat-resistant steels. "The big push today is in the automobile sector and grinding," says Bruno Wagner, of S2M, a subsidiary of SEP [European Propellant Company]. S2M's magnetic bushings are used (in competition with conventional roller or hybrid bearings and air bushings) in the high-powered electrodrills needed for VHS machining. S2M has installed them in 10 Kapp grinding machines equipped with CBN [cubic boron nitride] grinders in service at ZF, the German equipment manufacturer, and more recently in a Prorectif machine delivered to the Ford plant in Bordeaux. Renault, for its part, is keenly interested in the VHS machining of mechanical components. Current developmental work in this respect concerns grinding, milling, turning, and boring of steel and cast iron parts, with production slated to start in 1992 and 1993.

A study on milling, by Renault's Organic Mechanical Methods Department, brings out clearly the effects of VHS machining on production lines and, in due time, on



the organization of the workshops themselves. To produce the gasket face of an engine's cast-iron cylinder head, two high-speed machines (one rough-facing and one finishing grinder) will suffice in place of the six machines currently distributed along two production lines (rough-facing, semi-finishing, finishing), with the intermediate stage performed by a single rough-facing machine serving both of the lines. The end result is a simplification of the lines, and the investment is half as much. From Fr60 million for the current configuration, it drops to Fr52 million with the intermediate stage, and to Fr25 million with the two VHS machines (around 20 percent more expensive than conventional machines) [this passage as published].

Thus, VHS machining is going to have a major impact on plant methods and procedures, on the organization of workshops, on the qualifications required of operators, and on investments. A turn in the road that French industrialists—and not only the big ones—will undoubtedly be having to negotiate very soon...

## European Just-In-Time Production Analyzed

### Applications to Industry

92WS0224A Paris LES ECHOS in French  
20 Nov 91 p 20

[Article by Roland Colin: "Production Management in the 'Just-In-Time' Era"; first paragraph is LES ECHOS introduction]

[Text] Increasingly randomized consumer demand, reduction of inventories, and upgrading of products, are piling headaches upon headaches for industrialists. The only effective weapon is the Just-In-Time (JIT) production system. This has one difficulty: That of its implementation.

"Your eyeglasses in an hour..." Displayed in opticians' windows, these alluring slogans express to perfection the ultimate goal of the "Just-In-Time" (JIT) philosophy: To respond nearly in real time to a client's demand. An approach based on organizing production so as to best manage the growing complexity of modern production systems. Its underlying theme: Service to the consumer. It is not surprising that the champions of JIT are all Japanese. Three men are at the origin of the concept—Sakichi and Kichiro Toyota, successively presidents of Toyota Textile and Toyota Motor Company, and Taiichi Ohno. The real inventor and tireless artisan of this new form of organization, Taiichi Ohno made his debut in the group's textile company. Then, in 1943, he transferred to its automobile sector. An amusing detail: It was while in the United States in 1965 studying the supply methods of the American supermarkets that he found the roots of that idea. After World War II, Taiichi took a closer look at the organization of the American automobile market.

## Japanese Kings of JIT

His genius lay in understanding that the necessary approach, contrary to that of General Motors, Ford, Chrysler, and others, based on mass production of large quantities of a reduced number of models, must absolutely be to produce small quantities of many models, economically.

To attain American productivity (nine times higher to that of the Japanese in the 1940's), only one way was open to Ohno: Organize production in such a way as to eliminate wastes (inventories, scrap, handling, untimely stoppages of the machinery,...). Taylor was dead, long live JIT. The 1973 oil shock marks the entry of Japanese industry as a whole into the JIT era. Today, the entire planet is seeking to convert to this new production model.

It all began with putting the stockrooms on a diet. The absolute goal, never attained by the Japanese: Zero inventory. Rather, the aim must be optimal inventory levels. "Reduce inventories, yes. But which ones?" wonders Jean-Claude Gorenne, procurement manager at Renault. The benefits of the conversion are evident, of course, as long as the inventories represent a heavy burden for an enterprise. "There are useless inventory levels, but there are also intelligent ones, without which there is the risk of losing an order, indeed many orders," he adds.

A small reserve inventory can compensate for an unexpected incident (a transport tie-up or a strike) capable of destabilizing a system as fragile as JIT. "Zero inventory and Just-In-Time are often mistaken for one another," says Francois Lerique of CEGOS [Commission for General Study of Scientific Organization]. Though it is but the first step on the road to JIT, the reduction of inventories is nevertheless a useful indicator for judging a company's health. According to an INSEE [National Institute of Statistics and Economic Studies] study, the lowering of inventories of materials in industry (as a ratio of purchases) between 1985 and 1988 was of the order of 5 percent. The movement was more marked among prime-contracting enterprises (-6 percent) than among subcontractors (-3 percent).

The automobile sector, one of the first to adopt this philosophy, confirms this observation: -25 percent for the big names versus -17 percent for the PME's [Small and Medium-Sized Businesses]. A result obtained through a very intensive JIT approach. As of now, certain components (seats and gas tanks) arrive in place on the production line at the exact moment called for. Inventory levels have dropped substantially in the producer goods sector (-12 percent). On the other hand, intermediate producer goods enterprises, which are very sensitive to variations in world prices for raw materials, have not reduced their inventory levels.

### One Third of Enterprises Have Reduced Their Inventories

In three years, one third of the 7,000 industrial enterprises studied by the INSEE have succeeded in reducing their inventories by more than 15 percent. In another respect, 70 percent of the product manufacturing cycle is waiting time. Thus, the larger the lot to be produced, the longer is the waiting time. And in 99 percent of the cases, the workshop's machinery must be repositioned. Although this aspect of JIT discourages many an industrialist, it nevertheless offers many advantages: Inventories can be placed next to the machines (reduced handling), transfers of work pieces are facilitated, and the number of operations and loading stations is reduced.

In a JIT structure, everyone is the client or the supplier of someone, and team work necessarily becomes a part of these two worlds, which must adopt the same type of organization. Otherwise, the operation is doomed. On the other hand, if the required coordination is achieved, reserve inventories become superfluous. "The risks must be divided between the enterprises and their suppliers," says Alain Collaud of Orgaconseil. "The earliest possible integration of a supplier into the design and manufacturing processes of a new product is an approach that is being increasingly developed, especially in the automobile and aeronautical sectors. It replaces the good old purchasing contract," he says. In fact, if the automobile manufacturer operates in the JIT mode, the subcontractor has no choice: He must either adapt or perish.

But working in step with each other poses the problem of transport between supplier and client. A faulty transport system, as well as the risk of unforeseen social incidents at the supplier end perturb the JIT system. The reality of the Cleon strike shows that such incidents can perturb the process as a whole. "Effective action plans must be drawn up premised on catastrophic scenarios," says Francois Lericque.

### Fr1 Billion in Economies at Renault

This said, neither strikes nor transport system malfunctions need represent valid reasons for forgoing conversion to the JIT model. The stakes are too high, and the benefits are considerable. "The annual savings realized by Renault through the JIT system (parts and materials handling, gains in floor space, lowered inventory costs) amount to over 1 billion francs[Fr]," says Michel Praderie, the firm's secretary general. "Our manufacturing inventories have shrunk from 14.4 days in 1985 to 5.8 days in 1990. To say nothing of the gains in flexibility and the ability to react faster to the needs of the marketplace: A question of survival for all the automobile enterprises."

Be that as it may, an enterprise in which the personnel are involved and dialogue is ongoing is less subject to a social incident. As for transport, it simply must be analyzed in minutest detail.

To the technical difficulties, human resource problems must be added, inasmuch as they can constitute the principal snag to implementation of the system. For example: The training and versatility of the personnel as a group is the keystone of the concept. The absence of one of the operators must not bring production to a halt: Another must be able to replace him or her without a hitch in the process. Neglecting to train the supervisory personnel (whose role will dwindle) is one of the deadly mistakes in the implementation of the JIT system. The change to a hierarchy that contains not more than two or three levels changes their position. Result: They try their best to bring this approach to a grinding halt.

### Industry Specialist Interviewed

92WS0224B Paris LES ECHOS in French  
20 Nov 91 p 21

[Interview with Pierre-Marie Gallois, JIT [Just-In-Time] specialist at Cap Sesa: "A Means of Survival"; by Roland Colin; place, date not given]

[Text] [Colin] How do you define the Just-In-Time [JIT] approach?

[Gallois] Actually, a certain confusion reigns in the terminology of the concept, which renders its definition too restrictive. To say that "Just-In-Time" is a philosophy that eliminates waste, reorganizes the flow, reduces inventories, etc... is fine, but it is not enough. Because the JIT objective is to eliminate the causes of these factors, not the effects. A medical analogy might clear up this question: When an enterprise is attacked by "microbes"—that is, excessive inventories—the illness must be fought by using "antibodies." The "antibodies" are the JIT techniques.

[Colin] How is the sphere of applicability of the concept delimited?

[Gallois] The attempt to limit the applicability of JIT to production is another example of a prevailing misconception. Actually, the concept must accompany the entire life of a product, from its design to its delivery to the customer. The fact is that 70 percent of the costs of inferior quality are generated by poor design of the product, and the lack of coherence with its manufacture. Another fact is that JIT can be applied in many domains other than that of so-called repetitive production processes. Enterprises are increasingly accepting this reasoning. One example, among others, is Aerospatiale, which is embarking on a large-scale JIT project. There are cases, of course, in which JIT is not viable or impossible to apply at the present state of the techniques, like steelmaking, for example. The questions of applicability and economic viability must be analyzed case by case.

[Colin] In your opinion, what are the difficulties and mistakes that must be avoided?

[Gallois] The most important but also the most difficult thing to achieve is assured reliability and reproducibility of the physical flow. In other words, eliminate the fluctuation of the means of production, of tolerances in the manufactured product, and of the planning system. But it is every bit as essential to also reduce tool-changing times, which are still too long, reduce the size of lots, and install equipment accordance to a flowchart, and not by specialty. And though it is a statement of the self-evident, training and motivation of the personnel (multiple specialization, versatility, first level maintenance, job latitude,...) nevertheless remain the prerequisites sine qua non of success.

[Colin] There are managers who distrust a concept that can be destabilized by the least social movement, or a transportation mishap. Do you consider this justified?

[Gallois] True, a JIT production system is more fragile, in that the protection afforded by inventories no longer exists. But the real results of JIT become evident after its installation: Its benefits can be considerable. In any case, those who do not think in terms of JIT, faced by competitors who do, risk being relegated in due time to the pages of textbooks on industrial history.

#### **Siemens Automotive Reports Benefits**

92WS0224C Paris LES ECHOS in French  
20 Nov 91 p 21

[Article by R. G.: "Siemens Automotive: A 30-Percent Gain"; first paragraph is LES ECHOS introduction]

[Text] Siemens' subsidiary, Siemens Automotive, which specializes in electronic systems for automobiles, manufactures more than 5 million components a year. Today, its production is organized around "Just-In-Time" [JIT].

Reduced production times, inventories, and process times, and improved information flow: The objectives of the "Just-In-Time" [JIT] project instituted at Siemens Automotive were ambitious. The German group's subsidiary specializes in the design, development, and manufacture of electronic systems for automobiles, employs 1,310 persons, and manufactures 5.1 million products. Not less than 7,000 illumination modules, 2,500 electronic control units, 1,000 ABS [antilocking brake system] computers, and 8,000 magnetic sensors roll off of its production lines daily. A veritable headache for its production managers and staffs.

In 1980, the company decided to computerize its operation, adopting the MRP [Manufacturing Resource Planning] philosophy. "In 1985, very wide-ranging sales fluctuations linked to increasingly shorter-range planning objectives compelled us to modify our production management strategy," says Francis Peyronnet, head of manufacturing services.

That was the start of a Kanban project, which today is posting stunning results: Reduction of manufacturing process times to 30 percent, disappearance of product

obsolescence (a subassembly is not produced until it becomes necessary), elimination of planning personnel, a greater degree of self-sufficiency among operators, and improved flexibility.

#### **Regrouping of Managers**

The first action undertaken: Reduction of the overall manufacturing cycle by reducing process inventories to the strictly necessary. From the human resources standpoint, production and scheduling were grouped and assigned to one and the same team so as to establish links between the subassembly manufacturing shops and the finished-product production lines.

Result: Production planning is no longer based on an inventory-level objective, but rather on effective needs of the client. Every production workshop is controlled, therefore, by means of Kanban cards, which show the stipulated requirements and are adapted to the types of packaging delivered to the client. These cards bear the product part number, its designation, and the number of pieces per package, thus facilitating the planning and tracking of the products. They are affixed to the packaging and control the routing of the product among the client and supplier stations within the production workshops. "For greater flexibility, we also use charts providing the controllers of automated equipment and production line operators the latitude they need to launch their own production," he says.

#### **Use of Bar Codes**

The Kanban system, as the real core of the management system, informs all the operators producing a subassembly. The frequent changes of lots introduced by the Kanban system, however, have increased the number of manufacturing orders, which the MRP II system continues to manage. "In fact, when the MRP computes, it uses 'manufacturing process times' data. The Kanban system, on the other hand, plans and controls workshop operations and gives no information to any data processing system whatever," Francis Peyronnet points out.

The most recent development: Use of bar codes to call for components from stores or suppliers, and to update in real time the data on process times between zones. "The objective is to extend the Kanban system to our suppliers and our warehouses and thus eliminate the need for manufacturing orders," he adds. "The daily automatic transactions thus deliver the information concerning in-process times by reference number: It is the only information the MRP II needs in order to function properly."

#### **European Market for High-Tech Factory Automation Analyzed**

92WS0225A Paris LES ECHOS in French  
20 Nov 91 p 20

[Article signed R.C.: "A 28-Billion-Franc Market"]



[Text] The computer-integrated manufacturing [CIM] market consists of a whole series of hardware and software, ranging from numerical-control machine tools to computer-aided design and industrial robots. According to the BIPE [Bureau of Economic Information and Forecasting], total worldwide sales in this sector amount to \$67 billion. In France, this is a 28 billion franc[Fr] market with an annual growth rate of 7 to 20 percent. The techniques involved affect all industrial sectors. They are the results of three major activities: data-processing products (e.g., computer-aided design), mechanical-type products (machine-tools, industrial robots), and finally electronic-type components (programmable controllers, measuring sensors). At present, the automobile industry is the leading consumer of such systems, followed by electrical engineering and the mechanical industries.

The world market also consists of three major geographic zones: United States, Japan, Europe. The French market (the second in Europe after Germany), represents about 6 percent of the world market. Of all European countries, Spain is currently the one with the highest growth rate.

In terms of technologies, industrial network systems are experiencing the most spectacular growth (+21 percent per year) ahead of computer-aided production control systems (+14.6 percent), and industrial robots (13.5 percent). These data are for the mechanical industries, where the automobile sector preponderates.

#### **1,500 New Robots Per Year in France**

Note also that, by business volume, numerical-control machine tools are far ahead, although their growth is slower than the average for other types of equipment. This activity amounted to Fr3.6 billion in 1980. It is followed by computer-aided production control systems (Fr464 million), and machine-tool numerical controls (Fr417 million). During the same year, 1989, industrial robots accounted for a volume of Fr180 million.

There are today [sic] about 400,000 industrial-type robots in use throughout the world in 1990 [sic]. Despite the diversity of definitions adopted for equipment of this type, Japan is the leading user worldwide, with 240,000 robots installed. The United States (45,000 units) ranks second. In Europe, Germany is the leader (28,000 units), followed by Italy (12,000), France (11,000), and Great Britain (7,000). This sector, which was marked in recent years by major mergers, is now in the hands of two multinational giants. On the one hand, the ABB (Asea Brown Boveri) group which expects to sell about 3,000 robots this year. On the other hand, the U.S.-Japanese partnership between General Motors and Fanuc. Between themselves, these two groups control about 60 percent of the world's robotics. In France, about 1,500 new industrial robots have been set into service every year since 1989.

Another fast-growing market is that of industrial local area networks. This generic terms covers in fact all systems that make it possible to convey production data

within a company. These networks, with an average length of about 1 kilometer, are usually installed on production sites. It is through local area networks that all production-equipment information and operating orders are transmitted.

A local area network is indispensable whenever several automated units operate simultaneously in a plant. The network, therefore, is truly the spinal chord of a modern production system. The proliferation of computer-aided design stations and automated production systems results in a veritable boom for industrial local area networks. According to the BIPE, all these applications should experience an average growth rate of 21 percent during the next four years. The 1991 market, estimated at Fr371 million, should thus reach Fr811 million by 1995.

#### **Italian Firm Develops Automated Measuring Systems**

92MI0235 Turin *MEDIA DUEMILA* in Italian  
Dec 91 pp 64-68, 70-71

[Article by Claudio D'Amico: "DEA Measuring Robots"]

[Excerpts] Four state-of-the-art plants, one inaugurated just a few weeks ago, more than 1,000 employees, 140 billion lire in annual revenues, and many "projects on the drawing board" to gain the control of the world market for measurement robots over the next five years. This is the profile of DEA [Digital Electronic Automation] of Moncalieri, near Turin. The company, part of the Eltag Bailey/IRI [Institute for the Reconstruction of Industry] Finmeccanica [Technal Engineering Finance Corporation] group, is known throughout the world for having designed and constructed the most sophisticated measuring systems for the automotive and aerospace industry.

In greater detail, exports account for approximately 80 percent of revenues. The company has branches in the United States, Japan, the UK, Spain, France, and Germany and representative offices in another 50 countries throughout the world.

#### **The Ace 10 Robot—DEA's Treasure**

The latest treasure at DEA is a three letter word followed by a number. It is the Ace 10 robot, a state-of-the-art solution for all applications requiring high precision combined with high dynamic performance. It is no chance that Fiat recently assigned DEA a large two-year order for the supply of measurement robots to be installed at the Turin and Pomigliano d'Arco plants.

"The first order," explained Franco De Gennaro, DEA's general manager and managing director, "for 18 high-technology cells to measure bodywork and forged parts, is worth 19 billion lire. These orders are part of an investment program that calls for a total of 24 systems worth more than 22 billion lire. Ace 10 will be installed



for testing mechanical parts, while Bravo robots and the self-rigging Five systems will be used for testing body-work and drop-forged parts."

"The importance of this order," De Gennaro added, "is not just its economic value: These 24 robots will be added to the more than 120 DEA measuring machines already operating in Fiat plants, proof of our company's state-of-the-art technology. On the other hand, it demonstrates the commitment of the Mirafiori company to achieving targets for excellence in the quality of its vehicles."

According to DEA researchers, their latest "creation" has 10 main features: 1) a very high degree of productivity;

2) extremely precise measurements;

3) a revolving table integrated into the robot's monolithic structure, easy accessibility for loading/unloading operations, be they manual or automatic;

4) a mandrel made of carbon fiber, a material that combines lightness, extreme strength, and inertia to thermal changes in the environment;

5) the possibility of internally conditioning the robot's structure;

6) high resolution, optical linear transducers;

7) protected slideways;

8) high-performance drives that have been optimized to guarantee the quick, uniform movement of moving parts;

9) a mobile aluminum structure, both light and strong, enabling it to achieve high speeds and an optimum reaction to thermal variations in the environment; 10) static base in stabilized welded steel for a high strength/mass ratio.

Maurizio Ercole, marketing director and originator of some of the systems developed by DEA stated: "'Ace 10' is an exceptional robot that can make measurements to within a few microns in extremely severe industrial environments, for example between milling machines and boring machines. The machine also has a revolving head that allows the sensor to assume different positions in addition to automatically changing the sensors used. There are highly sensitive pads around the machine which stop the robot as soon as they are stepped on. This solution was adopted for safety reasons, since personnel access is forbidden unless the power to the engines is turned off. If someone accidentally enters the enclosure containing the machine, its activity will be interrupted immediately." [passage omitted]

#### A Look at the Near Future

DEA has clear-cut goals for the future: increase its share of the world market from 15 to 20 percent in five years, thus attaining world leadership in the field of measuring robots and machines. "The company's development

strategy," explained De Gennaro, "is based mainly on intensifying its research into new products associated with optimizing applications in order to penetrate new markets and strengthen industrial and marketing dynamics."

Asia and eastern Europe are where DEA is currently focusing most of its attention. "We have set up a Singapore office," De Gennaro continued, "taking advantage of Elsag's presence there, in order to expand the Asian market, where we are already present in China and Japan. There is a price war going on in these countries, especially for the smaller machines, so we need to be very competitive and we are trying to do just that. The first phase of the Singapore operation will be commercial, through the commercial-technical and applicational demonstration center we have set up there. A great deal of attention is also being placed on eastern Europe, despite the current difficulties," he added. "Along with Finmeccanica, we have developed a strategy for Russia and the provinces that are showing themselves to be the most active, including the Ukraine. Our presence is oriented to looking for people on the Russian market who can manage local businesses and not central businesses the way they used to do. Now business is more decentralized and we must go to various companies to make ourselves known."

"We are also expanding working agreements with a software house in Israel and with the Japanese at Toyota to supply our products to their international plants. Furthermore, we are also looking at purchasing the metrology division of the American Giddins and Lewis company at Sheffield, after abandoning the idea of purchasing LK (Cincinnati Milacross Group) in the United States.

Our R&D sector is fundamental. "This year we will spend approximately 15 billion lire," concluded De Gennaro. "This is rather a large sum for a company that differs from its Japanese and German competitors in that it occupies only one sector. Research however is very important, and we are acting to find synergies that will channel more expertise into this sector, where we employ more than 120 people."

#### Introduction of CIM Into Eastern Germany Promoted

92WS0242B Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT in German 19 Dec 91 p 1

[Unattributed article: "Introduction of CIM in Eastern Germany Promoted; Research Ministry Provides 100 Million German Marks [DM]" ]

[Text] Bonn—In order to speed up the introduction of computer-integrated manufacturing (CIM), the Ministry for Research and Technology is providing 100 million German marks [DM] for companies in the new Bundeslaender, beginning on 1 January. This has been

announced by the ministry in Bonn, which noted that this support underscores the significance of computer-supported production with regard to the international competitive situation as well.

In the interim balance sheet for a "manufacturing technology" aid program which was launched in 1988, the ministry pointed out that more than 92 percent of the companies receiving funding to modernize their production, especially in the field of machine-tool manufacture, have used it as an impetus for application of CIM manufacturing technology. Funding of DM300 million has been used to sponsor 1,232 companies, of which a good 92 percent have fewer than 1,000 employees. In the meantime, 350 projects have been completed.

The aid program, which included funding totaling DM583 million, has also been applied to the establishment of 21 CIM technology transfer centers thus far, including five in eastern Germany with sites in Chemnitz, Dresden, Magdeburg, Suhl, and Wismar. There are 46 college institutes involved in formulating and providing CIM know-how. With the motto "Factory of the Future," support is also being provided for a number of joint projects—including some on the European level—the goal being to modernize assembly techniques.

The interim balance sheets states that in many cases there is a "growing trend" for assembly costs in industrial production to account for between 20 and 50 percent of manufacturing costs. The level of automation reportedly remains too small. According to the justification for the support funding, the competitiveness of German and European industry is "essentially defined by an accelerated solution to assembly problems." There are 17 countries involved in a corresponding project, FAMOS (flexible automated assembly systems) within the framework of the EUREKA cooperative research project alone.

#### **Germany: Transputers Used To Control Robots**

92WS0248A Landsberg ROBOTER in German  
Nov 91 pp 22-24

[Article by professor and Doctor of Engineering Paul Drews and diplomate engineer Stefan Arnold: Guarantees of Speed and Track Accuracy: "first paragraph is ROBOTER introduction]

[Text] New robot controls have a factor of 100 or even 1,000 faster reaction time to necessary path corrections than conventional controls. The permitted means of doping is called a transputer, meaning microprocessors, which allow parallel data processing. The department for Process Control Robotics in Welding Technology at the RWTH [Technical University of Rhineland-Westphalia] in Aachen envisions the main application field in sensor-guided robots.

Using the transputer technology means a clear improvement in the key control-technical data. Coordinate transformation times of up to 0.1 ms are already being

realized. This is about a factor of 100 to 1,000 below the times needed by today's robot controls. In this connection, special note should be taken of the dead time. The control reacts to Cartesian path correction values with delays below 1 ms. On the one hand this represents a significant improvement in comparison with existing control systems, and, on the other hand, in order to use these advantages high demands are placed on the mechanics of the manipulator as well as on the speed of the connected sensor system. It turns out that transputers offer a promising solution to build control systems for the future.

An increase in flexibility, assuring that the processing quality remains the same and verification and documentation of welding results require the use of external sensors in automating the welding. In order to detect geometric magnitudes such as joint form, relative joint position as well as torch distance and orientation, a number of sensors have been developed in recent years which are usually based on optical measurement principles. Apart from special tasks in quality assurance, for which pure documentation of parameters relevant to the quality is sufficient, it is also necessary, in addition to the measurement technique, to effect a corrective influence on these magnitudes.

Due to their major flexibility robots are gaining importance in arc welding, particularly for guiding the welding torch. In order to control the welding process in a precise manner through geometric parameters—these can be the torch distance or its orientation, for example—it is necessary to construct control circuits which take the robot system into account. For conventional robot controls this requirement is limited by a whole range of deficiencies:

- Often, only interfaces for widely scattered sensors (such as arc sensors) or for special sensors from the robot manufacturers are available. But it is not possible to couple any other kind of sensors via these interfaces.
- General sensor interfaces which enable the coupling of Cartesian correction data, are dependent in their pulse rate on the speed of the path interpolation. Typical clock rates are here 10-50 Hz. This is only sufficient for relatively slow-working movement influences

#### **Dead Times and Limited Modularity Influence Performance**

- Typically, correction signals need a throughput time in the control of 2-3 clock cycles. The result is thus a dead time of up to 300 ms, before the robot control can react to the variations perceived by the sensors. When constructing control circuits that use the robot system as an actuator this dead time becomes the dominating magnitude.
- The control systems used are only modular to a limited extent. For the increasing demands this hampers the expansion of their performance capability with regard to processing speed and number of interfaces

- Details of the internal signal processing as well as the control architecture are frequently not documented. Furthermore, they are kept secret by the manufacturers in order to protect their market. Therefore, it is not possible to have the specific influence on certain areas of sensor signal processing which would be necessary to develop the sensors.

The above problems caused the scientists for process control in welding technology at RWTH Aachen to begin developing their own control system for industrial robots about 18 months ago. An important aspect of this new development was to be the expandability of the control with respect to future increases in demands. In this respect the use of transputers as representatives of modern parallel computer concepts is almost self-evident. The transputers involve microprocessors with a fast RISC architecture. In order to accelerate memory operations they have internal RAM and support mathematical operations through an FPU (Floating Point Unit) integrated on the chip. Insofar they resemble the modern i486 processors from Intel. But as a special characteristic they have four serial interfaces, the so-called LINKs. These enable a simple coupling of several processors with a data rate of 1.5 MByte/s. The data exchange via the links is supported by a DMA controller, so that running calculations are not hindered.

By connecting several processors through these link interfaces it is possible to build up networks, the configuration of which can be adapted to the tasks in each case. The most important difference between them and conventional bus architectures consists of the fact that when using an increasing number of processors the number of communications channels also increases. For systems with bus architecture this is not the case. Here, an increase in computational performance by using more processors can only be achieved with great limitations, since any communication has to take place through the system bus. Such bottlenecks do not occur with suitable programming in transputer networks. By this means the computing capability can be adapted to the demands within wide limits. Despite the indicated advantages, transputers have so far been used less for control purposes than principally for calculation-intensive tasks such as volumetric calculations, simulations and FE [finite element] calculations. For use as online control systems only few additional components are offered at this time, so that some obstacles still had to be overcome.

The concept of a transputer-based robot control began by analyzing the functions of existing robot controls. In so doing, it turned out that tasks are also undertaken through the functions for controlling the mechanical system in robots which reasonably fall within the domain of a cellular computer. Thus, in addition to steering toward path points, parameters for control of welding sources as well as control signals for security installations and other handling equipment (for example, positioning tables or material feed) can be stored. For the new concept these functions should again be separated in order to support a modular concept at the cellular level.

The individual control modules can be divided as a function of the data stream densities into various levels. Thus, the path planner is only called up before moving along a path. It sends the results of its planning, that is to say the interpolation type and bearing points, via the path planning corrector to the path interpolator. Using the interpolation clock rate the latter calculates the necessary intermediate points and passes these on via the path corrector to the coordinate transformation. Corrective intervention is thus possible by means of correctors and informers even at different levels.

So-called channels serve as a communications mechanism between the individual modules—insofar as they are not present as fixed hardware components. In the programming language Occam, specially developed for transputers, several parallel running processes can exchange data through channels. This is only possible, however, if sender and receiver are prepared so that a synchronization of the processes with each other takes place through these channels.

This modular concept offers the opportunity of flexible adaptation of the robot control to the demands imposed on it. In addition to an adaptation of the informers, this also makes application-specific adaptation of the correctors possible, since their parameters can also be dependent on the measurement principle used in each case. Another important advantage with this system, due to the in-house development, can be found in the accessibility and exchangeability of all modules. All internal information about the nature and speed of the signal processing is available for development tasks.

The previous application field for transputers lies in the area of "number crunching," that is to say in very calculation-intensive simulation procedures, on which no real-time demands are placed, however. Modules are also offered by some manufacturers, however, which effect the connection of a transputer network to the external world. Thus, modules for analog and digital input and output are offered which are approachable through link interfaces. The use of these components opens up problems as well, however.

With respect to the most far-reaching scaling ability possible in computing capability, the construction of slower but less expensive systems must also be taken into account. With such a system the effort is on keeping the number of processors as low as possible, which leads to the number of links available for connecting such components not being sufficient. The number of processors should therefore be increased beyond the number needed for the computing capability in order to offer the necessary number of link connections. This would lead to an unnecessary increase in cost, however. Furthermore, the expense for the input/output cards are also higher than is the case for standard components.



A remedy is found in the use of bus adapter cards, which enable the coupling of transputers with an input/output bus. In view of the previously mentioned principal disadvantages with bus systems this initially appears to be a contradiction. In systems which are required to produce high speeds, however, a distribution of the input/output components can take place over several bus systems, so that the individual bus systems do not represent a bottleneck. But in order to build low cost systems all input can take place over an I/O bus which is less expensive to put together. An adapter card was specially developed into a bus system which is already in use at RWTH for 6,502 and 68,000 applications. The low price of DM500 for such a card permits economical use of several adapter cards in a system.

Additional development steps in this field will be the integration of existing sensor systems into the present concept, as well as the creation of a programming system at the cell level, allowing the user to utilize the advantages of parallel programming in the area of machine programming as well.

#### **Germany: Ultraviolet Excimer Coating Technology**

92WS0253A Duesseldorf WIRTSCHAFTSWOCHEN  
in German 3 Jan 92 pp 50, 52

[Article by Klaus Jopp: "Processing: Hardening Radiation; New UV Source Opens Up Previously Inconceivable Application Possibilities"]

[Text] The tube would be a suitable addition to any haunted house ride. Eerily green, and sometimes blue or violet light streams out of it, while a shower of microflashes sparks inside it. The thing that would provide a horrifying highlight to any party is actually the unwanted side-effect of a commercially promising development by the Swiss research center of Asea Brown Boveri (ABB) in Baden. The ultraviolet light that is also emitted, and which is what the ABB developers are interested in, is invisible to humans. The Baden researchers are hoping for nothing less than a revolution in coating technology based on new excimer UV radiation emitters, which bring with them the potential for numerous applications in industry.

"Our radiation emitters will be significantly cheaper and also more reliable than lasers," Ulrich Kogelschatz, the project leader for UV generation and application in Baden, is convinced.

Even today, there are numerous realistic application possibilities for the new UV emitters. For example, paints and varnish, adhesives and sealing compounds, can be dried or hardened by UV radiation. Such processes are superior to conventional methods because on the one hand they require less time and energy, while on the other hand they are not associated with environmentally hazardous emissions. In addition, paints that are ultraviolet-sensitive dry in fractions of a second. They, as well as clear varnish, can be used on nearly all common materials, on metals as well as on wood, paper,

and plastics, although only theoretically. Existing UV emitters run at operating temperatures of up to 900°C. Even if kept at a suitable distance, paper and plastics run the risk of being singed. In contrast, the ABB emitters send out cold light. The principle of UV-hardening substances is based on the addition of so-called photoinitiators. UV light knocks out of them especially reactive groups of atoms, so-called free radicals, which trigger hardening or drying. It is precisely because of the fine-tuneable emission energies of the new UV emitters that the processes can be optimally controlled. It is even conceivable now to dry ink on freshly printed newspapers and magazines in very fast offset processes.

Excimers, a fragile chemical formation with a life of less than a millionth of a second, consist primarily of two noble gas atoms or a combination of noble gas and halogen atoms such as fluorine, chlorine, bromine, or iodine. The word excimer is derived from the English expression for an electrically excited molecule complex (excited dimer). Thus far, only lasers of the same name are known. Electric high voltage accelerates electrons inside the flask in which the active gas is trapped. When they collide with gas particles, these particles assume the kinetic energy of the electron. Excimers are formed, which in turn immediately give off the unusually high energy. They decay and in so doing emit ultraviolet radiation.

One of the most spectacular potential applications is the coating of any type of surface with metals. This method was contributed by the Heidelberg ABB research center. Extremely thin metal films play a prominent role as strip conductors or large-surface films in electronics, optics, sensor technology, and information technology. The Heidelberg metallization variant requires only a few process steps, is inexpensive, and is possible without expensive vacuum equipment, unlike conventional coating methods such as vacuum metallization, sputtering, or precipitation.

The substrate can be anything, but is mostly made out of plastic, as in the production of circuitry boards. The substrate is wetted with palladium acetate, a salt of acetic acid. The UV light destroys the salt molecules. What is left on the substrate is a rigidly adherent, thin layer of the noble metal, which acts as a primer coat. Using metallization baths, which work at moderate temperatures of no more than 100°C, the desired metals—such as nickel, copper, or even gold—are deposited on the palladium layer. Even textiles can be metallized in this way and then used to ward off electromagnetic interference fields, for example.

By using contact masks, structures or circuits with any degree of complexity can be produced in a single exposure. The palladium film adheres only at the exposed points. The acetate is washed off from the rest of the surface. Using this technique, strip conductors can be easily realized with widths of 10 to 50 micrometers. At present, structures of 100 to 200 micrometers are customary in this domain. Because of the great dispersion



power of the UV excimer radiation, it penetrates all openings, so that even components with complicated shapes can be metallized. Large-surface exposures are also possible. For this, several UV sources are combined. This variant can be used to decontaminate drinking water. For example, UV light decomposes the pollution-caused hydrocarbon molecules that permeate the groundwater in many places into their harmless components.

However, ABB is primarily interested in metal precipitation. "It has enormous potential," says Kogelschatz, who is consequently pleased with the marketing potential for his UV emitter. Industrial interest is tremendous, according to the ABB developer. The first devices are due on the market in early 1993.

### French Mechanical Engineering R&D Summarized

92WS0300A Paris ROBOTS in French 10 Jan 92 pp 1-4

[Article entitled: "A Summary of the MRT's Programs in Mechanical Engineering"]

[Text] The Ministry of Research and Technology (MRT) recently took stock of the programs it has been supporting in mechanical engineering since 1985 during a colloquium that was held in late December in Paris. The colloquium dealt with a number of topics. They included systems design and structures calculation; fluid mechanics, diphasic flows, dynamics, vibrations, noise, and systems control; the use of powerful lasers; machines and systems in optomechanical electronics; surface treatments; and micromechanics and nanotechnologies.

Mechanical engineering is crucial to many sectors both as a scientific discipline and an industry. The field employs nearly 1,800,000 people and generates sales of approximately 1,000 billion French francs [Fr]. That is nearly one-fifth of France's GDP (gross domestic product). Exports account for Fr400 billion of the field's sales. In addition, there are several very large, primarily export industries in which mechanical engineering plays a fundamental role: such as automaking, aeronautics, rail transportation, weapons, and so on. The mechanical engineering profession has announced plans to double its share of R&D monies, which now accounts for 1.7 percent of the total. There are nearly 9,000 mechanical research engineers affiliated with FIM [International Federation of Miners], which represents 545,000 employees and sales of Fr323 billion, 44 percent of them from exports. The public sector—the National Center for Scientific Research (CNRS), Atomic Energy Commission (CEA), National Office of Aerospace Studies and Research (ONERA), technical centers, and the French educational system—employs 4,300 researchers and technicians and 1,000 doctoral candidates. The quantity and quality of French research in mechanical engineering can be seen by the role it plays in EC programs such as Brite, a Community program dealing

with high-power lasers. France is participating in nine of the 12 programs that the EC launched between 1987 and 1989. It is the leading contractor for four of them, which deal with "surface treatments." Of a total of 48 EC programs, France is involved in 26 and is the primary contractor for 15 of them.

The Ministry of Research and Technology endows and subsidizes research organizations that perform both pure and basic technological research. It does this directly through:

- the research tax credit. Of the Fr2.4 billion in research tax credits that were awarded, 13.2 percent went to 1,394 companies affiliated with FIM. This is an increase of 40 percent in two years;
- CIFRES [expansion not provided]. These are available both to FIM-affiliated companies, which account for 5 percent of all contracts, and industries that are becoming highly mechanized.
- research grants. In 1991, 127 were awarded to mechanical engineering, or another jump of 40 percent in five years.
- the research FRT [Research and Technology Fund] direct subsidies. Several parties work together on these programs, which are selected through bid invitations. The programs have often led to increased support through "technological-breakthrough" and EUREKA program subsidies. (About 15 percent of EUREKA R&D involves mechanical engineering).
- ANVAR (National Agency for the Upgrading of Research) grants. ANVAR allocates about 35 percent of its grants to innovations in mechanical engineering and machines of all kinds.

FRT subsidies that have been granted since 1985, including bid invitations, direct subsidies, and technological breakthrough subsidies, are as follows: Fr51 million to machines, Fr5 million to maintenance, Fr8 million to structures calculations, Fr17 million to systems dynamics and control, Fr3 to optomechanical electronics, Fr43 to surface treatments, Fr4 million to the application of composites, Fr38 million to lasers, Fr3 million to flow in turbo-engines, Fr5 million to diphasic flow, and Fr3 million to nanotechnologies, for a total of Fr180 million.

Described below are a few of the programs underway. Some of them have already reached the industrial stage.

### The Atlas Laser Shop

As early as 1983, the laser robot tool of the future "Rolf" was one of the first topics to be analyzed as an "emerging technology" in the fields of machine tools and production systems. In 1985-86, the MRT awarded a grant to study its design: a multi-purpose flexible laser system. The goal was to achieve a technological advance in the mass production of tank bodies made of thick sheet metal (5 to 8 mm of very hard steel). Researchers sought to make a laser machining device that could automatically cut and weld the metal sheets so that the body parts could be assembled directly. The program spent two

years conducting feasibility studies on the cutting-welding device, one year developing industrial control parameters, and one year moving from flat-piece, two-dimensional machining to three-dimensional volume work. The organizations ordering the vehicles were then able to homologate the laser cutting and welding procedure. In 1990, researchers continued work on the program, splitting their time between Atlas studies and other duties. They worked on instrumentation and the auxiliary and peripheral equipment for the welding component (in particular, on an oscillating optical head made by Bertin to equip the 5Kw CO<sub>2</sub> laser beam). In 1991, researchers boosted the laser power to 14kW so that potentially stronger sheets could be worked more rapidly. There are also plans to use computer-assisted design and manufacturing to fully integrate the laser system into the flexible design and manufacturing process that has been implemented by the Mecanique Creusot Loire Company. Moreover, the program is still continuing. Several manufacturers who are interested in the control system and hope to diversify the device's applications are collaborating on it. The partners come together in the High-Power Laser Applications Laboratory (a joint CNRS-ETCA lab) and the Welding Institute. They are working on devising similar applications in other strategic sectors, among them hydraulic and gas turbines, vehicle chassis, railroad bogies, ship sections, the manufacture of tubes and pipes, cutting and welding of treated sheet metal, automobile mechanics, and more. Contact: Mecanique Creusot Loire, Etablissement St. Chamond (Jean Berniolles), telephone number 39.50.99.65.

#### Monitoring Machine Operation

The ready time of machines in some modern factories has been known to fall below 50 percent as a result of inadequate maintenance. This explains the interest in developing the notion of maintenance, both in the sense of failure prediction and upkeep. One approach to keeping the machines in good condition is to continuously monitor them and their tools in real time, in order to observe gradual shifts as well as any breakdowns. A black-box recording system can be used to filter and date useful data. Such a system requires that engineers first list all possible machine failures, their causes, and their effects, for each configuration. This in turn dictates that someone pinpoint the machine's sensitive areas, where the placement of sensors would be useful.

Researchers are presently expanding and investigating this approach for a few industrial applications. The applications being looked at include machine tools (precision lathes), machining centers, robots, compression engines, and handling equipment. The studies demonstrate potential gains from continuous monitoring. Besides increasing the ready time of the machines, black-box systems could be used to develop ways to prevent catastrophic breakdowns. This would improve safety. It would also increase the likelihood that individual workers and teams would apply the rules for operating and maintaining the machines and their tools.

Machine manufacturers are interested in monitoring for what they can learn about the stress spectrum of their machines and the conditions under which they are used. Machine users can employ monitoring for both short- and long-term tracking. It is an excellent tool for maintenance departments. Moreover, the ability of black-box systems to observe operations over long periods and to reject non-significant values before they are recorded makes them especially well suited to the monitoring and inspection of structures. Examples include measuring the dynamic stresses of cranes in order to determine the stress spectrum, inspecting dams and bridges, etc. If we consider all the ways that black boxes can be used, the range of applications is now very broad. They include inspection of container contents by insurance companies, tracking of abnormal events (such as monitoring of the French Electricity Company's supply disturbances, with exact dating of power failures), and remote monitoring (long-distance surveillance of a company's entire stock of installed machines). Black-box systems are also used as teaching tools at CETIM [Mechanical Engineering Industrial Technical Center] and in French schools. CETIM (Pierre Padilla, Christian Flambard) - 52 avenue Felix Louat, 60300 Senlis. Telephone: 44.58.34.22.

#### Integrating Thermochemical Surface Treatments

There are many advantages to integrating a thermal or thermochemical treatment into a production line that manufactures mechanical parts, such as engines. In particular, it is possible to do away with warehousing parts and transporting them to a specialized shop. The MRT subsidized a research program on thermal and thermochemical treatment procedures. The study investigated plasma-assisted nitriding and nitriding-derived treatments, commonly referred to as ionic-bombardment nitriding. It also looked at case hardening treatments, which have extensive industrial applications.

The temperatures at which surfaces are treated are sustained for three to four hours. Limiting cycle times to seven or eight hours means that the temperature-rise and cooldown times must each last about one and one-half hours. It also means that the other operations must be as short as possible. A hierarchy of automatons and programmable regulators control the different production steps and constantly optimize each parameter in the oven automatically. A computer that can be linked to a network and a general supervisory system controls the automatons and the regulators. The whole system assists in maintenance and stores the parameters. The setup can be integrated just as well into a line producing the same kinds of parts as into one producing different types of parts, that is, a flexible shop.

Line-integrated treatments have been most spectacularly applied to crankshafts of forged steel. Engineers installed three units—the first of their kind in the world—that were designed according to the above principles. The reactor, which has a useful diameter of 1,350 mm and measures 1,700 mm high, simultaneously treats 84 parts

with a unit weight of 20 kg. The whole system produces a total of 650 crankshafts a day. Several autonomous machines—not linked to the automated production process—produce the shafts. A supervisory system, which takes into account management of part-cleaning devices, the handling robot, general control, and storage, oversees the production machines. This system of discontinuous-treatment units actually combines to create continuous production.

The very same production units are perfectly suited to flexible plants. Manufacturers use a data bank, which can be extended to handle a variety of applications, to automatically control the different parts and treatments. The data bank can be installed into the memory of an individual machine's or group of machines' supervising computer. This approach has led to the development of many applications, both for steels and cast irons. Besides crankshafts, it has been used to make camshafts, tipper device rocker arms, transmission gears, equalizing gear cases, brake systems, cylinder rods, and so on.

#### **Turbomeca Develops Turbine Vane Test**

92WS0334C Paris *L'USINE NOUVELLE*  
*TECHNOLOGIES* in French 23 Jan 92 p 16

[Article by Bernadette Lacaze: "X-Ray Inspection for Vanes"—first paragraph is *L'USINE NOUVELLE* TECHNOLOGIES introduction]

[Text] By analyzing a mere X-ray picture, the Cristal system can check the single-crystal structure of Turbomeca turbine vanes.

While the use of single-crystal alloys to manufacture turbine vanes has increased the efficiency of these generators, the crystallographic quality of the material used also plays a preponderant part. "A vane deemed good may withstand gas intake temperatures 40°C higher than a vane deemed bad," Michel Meurtin, assistant to the head of the "metallurgical control" department, explained. Now, the higher the temperature, the higher the efficiency. To check the vanes, Turbomeca has developed a system called Cristal. In three minutes, using a single X-ray picture, it will measure the crystallographic parameters—in addition to detecting defects such as shrinkage holes, porosities, or inclusions. It can check that the vanes have a single-crystal structure, as it detects grains whose relative orientation exceeds 1. With a precision equal to this value, the system measures the deviation between the crystal axis and the vane axis, which corresponds to the direction of stresses in service. The Cristal system consists of a microfocus (less than 100 microns) X-ray generator, an image amplifier, a video camera, a vane-positioning robot with a 20-part feed carousel, and a computer system to handle control-command and the analysis of the images collected in real time. This analysis—this is the method's original feature—takes into account diffraction along the lattice planes; its effect is superimposed to absorption proper. The picture shows zones where transmission is stronger,

others where it is weaker, by comparison with the average flux transmitted. After identifying these points, it is possible to deduce the position of the lattice planes and their orientation with respect to the vane axis, the discontinuities disclosing the absence of a single-crystal structure. This technique requires no preparation of the object tested. For the time being, the decision still rests with the operator, aided by computerized means. But a study is in progress to automate image interpretation.

### **LASERS, SENSORS, OPTICS**

#### **French CNET Develops Advanced Optical Communications Laser**

92BR0150 Paris *ELECTRONIQUE INTERNATIONALE*  
*HEBDO* in French 12 Dec 91 p 4

[Unsigned article: "The National Center for Telecommunications Research (CNET) Paves the Way for Tomorrow's Optical Communications"]

[Text] It seems more and more clear that the broadband communications networks of tomorrow will take advantage of the properties of fiber optics, particularly their capacity to transport very large amounts of data. In this development toward "all optical" systems, a generalized use of optical-fibers requires the development of ultra-high-speed and economical endpoint components.

A step in this direction was recently made by the CNET [National Center for Telecommunications Research] laboratory at Bagneux. This laboratory indeed succeeded in integrating a semiconductor laser operating at 10 Gbits and a control circuit composed of two transistors on a single chip. Miniaturization of the interconnection contacts made possible by this integration permits the development of very-wide-passband modules (eight GHz measured). Moreover, compared to direct modulation of a nonintegrated laser, CNET's circuit resulted in a gain of 6 dB on the control power. This is a world's first, according to the CNET researchers, which places the French laboratory on an equal footing with the best of the Japanese and the Americans.

The CNET laser, a 1.3-micron BRS (buried-ribbon system) model, is produced on a semi-insulating InP substrate. The control transistors are of the MISFET (metal insulating semiconductor field-effect transistor) insulating-grid type and have been produced through ion implantation on the same substrate. Once assembled in the package which holds the passive components for electrical decoupling and a bootstrap, the circuit exhibited very good large-signal modulation characteristics (modulation current of between 40 and 50 mA) at 10 Gbits/s.

Once assembled, the performance of the laser and the two transistors is practically identical to that of discrete components: a threshold current of 9 mA and a maximum optic power for the laser of 12 mW, with a transistor transconductance of 80 mS/mm. This



transconductance level allows power control of the laser by means of voltage applied to the transistors' grids, with an efficiency of 12 mW/V. The small-signal passband (modulation current of about one mA) of the module constructed in this manner is eight GHz. Moreover, a perfectly opened eye diagram was observed for a pseudo-random sequence of  $(2 \times 10^{15}-1)$  bits.

### French ONERA Develops Hostile-Environment Camera

92BR0165 Paris *ELECTRONIQUE INTERNATIONALE*  
HEBDO in French 19 Dec 91 p 26

[Article by Serge Brosselin: "The First Camera To See Through Fire"]

[Text] The French ONERA [National Office for Aerospace Studies and Research] has perfected a camera capable of seeing through walls of fire while reconstituting an image in three dimensions of the scene observed.

This is one of the areas in which traditional video cameras are ineffectual. The exploration of hostile environments (cutting, soldering, working on high-temperature objects in ovens) is only one example. The ONERA started work on a highly sophisticated camera capable of adapting to very hostile environments. The fields of application of this camera, called TILT (Three-dimensional Laser Imaging Technique) ranges from robotics to certain aeronautical and military applications.

TILT in fact comes under the same series of studies as the Lidar (a "radar" based on the use of light beams) conducted by the ONERA over the past 10 years. Its operating principle is as follows: The beam of a continuously emitting laser diode scans, in the same way as a TV scan, the area to be visualized. This is done using deflection system based on vibrating galvanometric mirrors. When the optical signal backscattering from the target reaches the sensor, it is, after amplification, processed in two ways.

#### No Specific Components

The amplitude of the signal received is first analyzed. This is proportional to the albedo of the observed scene and provides the reflectance information. The image thus obtained is similar to that of a video camera, but it is independent of the ambient lighting. The ingeniousness of TILT lies in the fact that it uses the advantages of power modulation of the laser diode. Jean-Paul Cariou, founding father of the TILT research program, explains: "The detector receives a nonstop modulated signal between 0 percent and 100 percent, whereas all the sources of light at the scene—lamps, sun, spotlights, flames—emit continuous light. The detector, taking only the modulated signals into consideration, acts like a filter. It only picks up the modulation wave length and is, due to this, insensitive to the dazzling effect of the

parasite continuous light." Another considerable advantage is TILT's operating principle which eliminates the highly delicate problem of cast shadows which fools all other present-day cameras.

The second measuring method consists in analyzing the modulation of the signal received by the detector, which is identical to the one printed on the laser diode on emission. Telemetric data is obtained because the phase shifting observed between these two modulations is a function of the laser beam's to-and-fro movement. A second processing step, which consists in converting the phase shift into a chromatic signal, allows image relief extraction.

The two images—reflectance and relief—are both obtained at TV rate and in parallel. Initially, the choice of laser was made traditionally on carbon-gas lasers, which are beneficial because of their high power and output. The only drawback was the weight of the associated overheads—especially the laser cooling equipment and detectors. The arrival in 1986 of the first laser diodes permitted a more pragmatic approach. Because of their low power, the laser diodes used in the TILT camera do not have as good a performance range as a CO<sub>2</sub> laser. Nonetheless, they are, according to Jean-Paul Cariou, rapidly tunable in power and this at very high frequencies. The feasibility of TILT is the result for the greater part of this one essential characteristic.

The development of TILT has not however led to the development of specific components. The logarithmic amplifiers, demodulators and phase shifters it uses are available from foreign markets. The amplifier is manufactured by the British firm Pascal which specializes in the defense sector. The phase demodulator is provided by the Japanese company Reka ("distributed" by Septi in France).

The signal processing technologies used are borrowed from radar techniques for very-high-frequency processing in the 100 MHz band. This processing is carried out digitally. This is mandatory because of the scanning principle, which makes use of two deflection mirrors. The field sweep mirror scans at 25 Hz and the line scanning mirror operates in resonance mode at 4,000 Hz. The oscillation is produced by a resonant galvanometer whose principle is similar to that of a loud-speaker. In this case, the galvanometer is excited by the resonance frequency of the mobile equipment. It is therefore possible with extremely weak movements to obtain significant but sinusoidal scans. Image distortions inevitably follow because the sinusoid necessarily spends longer on the edges of the image than in its center. This phenomenon must be corrected and this is done digitally.

The industrial spin-offs of the TILT camera are promising. SPIE [Public Economic Interest Company]-Batignolles, the CNES [National Center for Space Studies], and CERT [European Radio and Television Center] are said to have expressed interest already. The ONERA raises a certain number of arguments in favor of



TILT. With a traditional stereoscopic camera, relief can only be restored through the use of computers and by a lengthy procedure (roughly one second is required to process a single image). The distance information is also directly available in digital format and does not require triangulation and trigonometrical calculation.

TILT's distance resolution is to the tune of 1 percent to 1 per million of the range. This precision is directly proportional to the signal-to-noise ratio of the measure. The further away, the more the signal decomposes, which explains the 1 to 10 fork in resolution performance.

Although the TILT camera is a unique prototype in the world today, the system needs to be further developed. The increase in the power of lasers would enable a range of over 1 km to be considered. A new field of application could then open up in the area of airborne visual equipment. Helicopter crews in particular would no longer need to dread high tension wires. TILT would be instrumental in locating them and could become a serious competitor of the Romeo 2 radar system, which operates on millimetrical waves and was developed especially for this purpose by Thomson-CSF.

#### [Box]

##### Technical Characteristics

Optical wavelength: 0.8 micron

Field of vision: 20° x 20°

Angular resolution: 1 mrd (0.06°)

Number of points: 256 x 256

Image rate: 25 Hz (video)

Range: 20 meters

Distance resolution: 1 cm

#### Germany: Trumpf Institute To Develop 40 Kilowatt CO<sub>2</sub> Laser

92WS0180B Paris INDUSTRIES ET TECHNIQUES  
in French 15 Nov 91 p 15

[Article by Mirel Scherer: "Trumpf Is Preparing a Super-laser; Jointly With the Fraunhofer Institute, the German Company Is Aiming for 40 Kilowatts"]

[Text] Not content with having developed its own CO<sub>2</sub> laser source, the German Trumpf is embarking on an ambitious research project: the development of a third-generation CO<sub>2</sub> laser capable of achieving or exceeding 40 kilowatts [kW], in cooperation with the Fraunhofer Institute of Aachen.

"Introduced during the 1970s, first-generation lasers were limited to laboratory developments and offered power outputs ranging from 500 watts [W] to 1 kW," Eric Gallou, head of the laser department at Trumpf France, pointed out.

"Industrial second-generation lasers used new technologies, such as high-frequency excitation, and offered power outputs of about 6 to 10 kW."

New excitation techniques developed under the project will contribute to the development of very compact lasers, with a high-quality beam, and capable of achieving power outputs of several tens of kilowatts (40, even 60). These will pave the way for new applications, in particular in the steel processing industry: welding of thick parts, large-scale surface treatment such as plating, or surface alloying. "The key factor is higher laser-machining speed, slitting and assembly techniques requiring no rework, and minimum stressing of the materials," Eric Gallou explained. "Innovations will have repercussions in low-output laser technology."

The project, in which five to 10 researchers will participate, will be completed over five years, with a budget of about 70 million francs [Fr], half of which will be provided by the land of Rhineland-Westphalia. The latter already contributed to the installation, at the institute, of a 22-kW laser for pure research, and another 25-kW laser to test the potential applications of very powerful lasers. As an example, the most powerful laser in France (22 kW, supplied by the American company United Technology) was installed three years ago at the Central Weapons Technology Establishment (ETCA). It is used to explore the potential industrial applications of lasers with such a power output.

#### A Laser Adapted to the Needs of the Industry

The approach is the same at the Aachen Institute, where research performed with the 22-kW and 25-kW lasers has already opened new market outlets: machining of tubes and very thick (20-40 mm) metallic structures, coating and plating of sheet metal and tubing, etc. But it has also shown that these lasers, which still represent a prohibitive investment for companies, are not technically suited to industrial needs. According to Dr. Loosen, the project head at the Fraunhofer Institute, "they require additional work on the physical theory of the laser phenomenon in order to improve the quality of the beam and its modulation capacities. We shall test the various solutions under this project, but it is premature to say which one will be selected." Hence Trumpf's interest in this third-generation laser, the industrialization of which it will carry out.

The collaboration between a machine-tool manufacturer and the Fraunhofer Institute is typical of the German industrial R&D method. It ensures that a high scientific level is allied with the consideration of users needs: affordable prices, reliability, and ease of operation.

### Germany's MBB To Develop Microlaser

92WS0181B Frankfurt/Main FRANKFURTER  
ZEITUNG/BLICK DURCH DIE WIRTSCHAFT  
in German 27 Nov 81 p 8

[Article: "Complex Microsystems on Chip Level;  
MBB Hoping for Numerous Technical Benefits From  
a Microlaser"]

[Text] Frankfurt (Scha)—Microoptics which first came into being a good 20 years ago and micromechanics which was discovered about 10 years ago are clearly lagging behind in development vis-a-vis the already 40-year-old microelectronics. Nevertheless, at present they are enjoying special attention as important cornerstones of microsystem engineering, for it will be possible first by means of further miniaturization to implement complex microsystems on the chip level and to find new areas of application for this technology.

The Messerschmitt-Bolkow-Blohm (MBB) company reports now in its house journal NEW-TECH NEWS (3/91) a significant turning point in the interplay on a shared chip of the three technologies named. This turning point is becoming visible now especially in laser technology in the construction of solid-state lasers. The company has set itself the goal of developing in the long term a microlaser designed according to microsystem technology, in which mechanics, thermal phenomena, optics and electronics interact in the tightest space.

Moreover, the microlaser will evolve in several stages. At the first stage, which has already been reached at MBB with the Modilas system, figuratively speaking, "the tube has been replaced by the transistor," i.e., the previous stimulation of a solid-state body by means of a discharge lamp has been replaced by semiconductor laser diodes as the source.

At the second stage, which has also already begun, the laser will be considerably reduced in size by means of a hybrid construction and connection technique. At the planned third stage a laser will be constructed on a silicon chip by means of the microelectronic fabrication process.

The microlaser's benefits vis-a-vis the hybrid laser lie, as described by the company, in its higher radiated power output and better frequency and amplitude stability. Additional benefits are hoped for in expanded sensor technology and control, and in the enhanced efficiency, reduced space requirement and lower production costs for this type of microlaser.

New effects of a positive and negative sort become manifest in the reduction in size of so complex a system as a laser. Because one is treading new ground here, exhaustive theoretical model calculations of the laser's thermal, mechanical and optical properties as well as of its spectral and time behavior are well to the fore today.

The ultimate aim of a microlaser is already being supported and furthered as well by extensive laboratory experiments.

### British University Develops Laser-Operated Optical Switch

92WS0269Q Chichester INTERNATIONAL  
TELECOMMUNICATIONS INTELLIGENCE  
in English 2 Dec 91 p 5

[Article: "University Develops Optical Switch"]

[Text] A team of researchers in Britain claims it has produced the world's fastest switch—a device operated by laser that could be capable of handling 2,000 simultaneous TV channels or 1.2 million telephone conversations. Officially known as a nonlinear coupler, the switch has been developed in Glasgow University's electronics and electrical engineering department and is based on a semi-conductor wafer.

The device operates by using intense pulses of laser light lasting 10 picoseconds. This means that future optical fibre communications systems will be able to handle much more information. Currently, optical fibres used in transatlantic links are capable of handling information at speeds much faster than those at which conventional electronics can operate.

Earlier this year, the new switch was tested at Central Florida University's Centre for Research in Lasers and Electro-Optics. It was tested with 10 picoseconds of light and was shown to be instantaneous on this timescale. Researchers believe the performance of the switch can be further sped up. They firmly believe this is the fastest semiconductor switch and that it should operate, at times, at 10 femtoseconds—a femtosecond is one thousandth of a picosecond. Another notable feature is that using the switch consumes practically no power.

### Sweden: New Laser Laboratory in Lulea

92WS0312A Stockholm NY TEKNIK in Swedish  
19 Dec 91 p 7

[Article by Hakan Bertmar: "Most Modern Laser Laboratory Found in Lulea"—first three paragraphs are NY TEKNIK introduction]

[Text] The country's most modern laser laboratory is located at the Technical College in Lulea

Here new technology is developed in cooperation with industry.

Laser-welded tubing for car radiators is one example of applied research.

The new laser laboratory at the Technical College in Lulea is very flexible. Here researchers can work on basic research at the same time as they carry out commissioned research work for industry.

"The coordination with industry is our strong point," said laser researcher Jan Flinkfeldt.

Among other things the nine-person laser group is working on a project that is being carried out in cooperation with Outokumpu Copper in Vesteras and Blackstone Sweden in Mjallby. It involves joining thin brass strips for radiators and car heaters.

#### Small Tube Roller

Today the strips are folded and sealed with solder.

In Lulea the laser group is experimenting with shaping the strips, which are only tenths of a millimeter thick, in a small tube mill, a machine that forms a cylinder, after which a laser beam is aimed at the seam to weld the strip into a sealed tube. The laser welding occurs at the same speed as the rolling operation, 100 meters per minute.

Laser welding provides better and cheaper car radiators and Blackstone Sweden could reduce the cost of manufacturing the 450,000 brass radiators and car heaters it turns out each year.

The laser group's own research is directed at cutting, welding and surface finishing with the aid of lasers.

#### Own Beam Switch

The heart of the laboratory is a beam switch the laser researchers in Lulea developed themselves.

The beam switch consists of a machine slide mounted in a turret that is 2.2 meters high. A number of mirrors are mounted on the slide. By allowing the laser beams to be reflected between the mirrors in various ways the beams from the laboratory's two lasers can be guided down to an optional workstation. This provides great possibilities for variation.

#### Precision Laser

In Lulea an investment of 16 million kronor has been made in a carbon dioxide laser with an efficiency of 6.0 kilowatts, one of Sweden's two most powerful working lasers.

"The new carbon dioxide laser is an axial flow laser. The technique produces better energy flux in the laser beam. We can cut steel plate with a thickness of 15 mm with no difficulty," Flinkfeldt said.

There is also a less powerful ND:YAG laser here that is used for precision operations such as laser welding where the laser beam is led through a fiber optic light guide.

## MICROELECTRONICS

### France's JESSICA ASIC Promotion Program Enters Second Stage

92BR0084 Paris *ELECTRONIQUE INTERNATIONALE* HEBDO in French 7 Nov 91 p 9

[Article by Didier Girault: "JESSICA Enters Phase II"]

[Text] After identifying the ASIC [application-specific integrated circuit] requirements of small and medium-sized enterprises and industries (SME/SMI), the JESSICA program is now embarking on its training, advisory, and assistance phase.

JESSICA is the French version of the JESSI [Joint European Submicron Silicon Initiative] subprogram to increase awareness of SMI's and SME's on the uses of ASIC started by LETI [Laboratory for Electronics and Information Technologies] and backed by the Regional Directorates for Industry and Research (DRIR) and the National Agency for the Implementation of Research (ANVAR). The program is now entering its second phase (training and technical assistance), after having successfully concluded its first phase, namely identifying the needs of SMI's and SME's and setting up a geographical structure adapted to meeting these needs.

At the end of its initial phase, JESSICA published the results of a survey involving 1,500 companies in the South, Rhone-Alps, Ile-de-France, and Greater West areas of France. This survey revealed that 4 percent of French SME's and SMI's already use ASIC's; 10 percent are ready to do so; 22 percent requested training; 28 percent advice; and 36 percent would like information on ASIC's.

Although French SME's and SMI's develop, in gross figures, only half the amount of ASIC's of their German counterparts, these circuits are more complex (standard cell circuits or gate arrays) than those produced across the Rhine (programmable logic or gate arrays).

Once the needs of SME's and SMI's were identified, the JESSICA board set up an infrastructure for information, training, and technical advice and assistance based on existing state and semistate laboratories involved in technology transfers. National coordination is focused on four centers corresponding to four geographical areas: the southwest; west; Paris-northeast; and southeast (Rhone Alps). The national coordinating body is managed by three officials drawn from JESSICA's three mainstays: LETI/CEA [Atomic Energy Commission]; ANVAR, and the CNFM [National Microelectronics Training Committee].

#### Support of Pooled Requirements

Phase 1 of the JESSICA program, which cost some 1.250 billion French francs [Fr], has also produced a list of the services offered by semiconductor manufacturers (European and others) and services companies established in

France. This information has been made available to SME's and SMI's to enable them to choose, if they need to, their foundry and services company.

JESSICA's aim is to provide potential users with all the technical information they might require. Another mission is to help SME's and SMI's develop a financial plan for their ASIC developments by explaining to them which subsidies (PUCE [Product Using Electronic Components] program, ANVAR, etc.) they are entitled to.

Indeed, the problems faced by SME's and SMI's embarking on ASIC development are many and varied. They admit to requiring training and information—provided by the CNFM through introductory ASIC courses (two days at Fr250 per day) and specialized sessions (Fr2,000 per day per trainee). They also recognized needing advice (regarding the important question of which ASIC to choose) and assistance with specifications development (10 days "preferential" assistance divided into a five-day session at a lump sum of Fr1,000 and five days at Fr2,500 per day, which represents half of what service companies charge).

These SME's and SMI's are seeking design consoles (available in JESSICA centers at market prices), technical assistance during design and assistance in negotiations with industrial partners (Fr5,000 to 6,000 per day, i.e., the market price).

The JESSICA program is original in that it supports projects decided on by "working groups" consisting of several SME's which decided to join forces to share design costs. The PUCE program does not cover this type of initiative, which is already common in Germany.

#### **No Competition for Manufacturers and Service Companies**

Executives at JESSICA are keen to stress that their program does not step on the toes of industry (foundries and services companies). It has even obtained the active support of industry which, at the risk of being overcautious, set up a joint supervisory body comprised of four regional associations. This body checks whether JESSICA does not exceed its authorized services range.

Furthermore, manufacturers (as well as the ES2 [European Silicon Structures] company) helped set up the program. JESSICA, in fact, does all the "dirty work"—potential customer research and information. ES2, which is specializing in the design of ASIC prototypes as well as in small and medium-sized batch production, has sought, ever since its creation, to make inroads in the SME-SMI market. It has said that it is more than satisfied with a program which enables small companies "to jump on the bandwagon."

#### **[Box] France and Germany Ahead**

Harmony is not yet the order of the day in Europe for JESSI's ASIC's subprogram. Germany and France are at the same stage of progress, the only difference being that

in Germany the financial and advisory/assistance aspects are not separate like in France, because both tasks have been given to the Fraunhofer Institute. Great Britain is a year behind and is currently working on the requirements of SME's and SMI's.

#### **Thomson Integrates Flash Memory With Microcontroller**

92BR0096 Paris *ELECTRONIQUE INTERNATIONALE*  
HEBDO in French 14 Nov 91 p 61

[Article by Francoise Grosvalet: "The First 16-bit Microcontroller with Integrated Flash Memory"]

[Excerpt] With a few world firsts in the field, SGS-Thomson is moving its pawns to quickly become one of the top five microcontroller manufacturers in the world.

SGS-Thomson, which aims for a place among the top-five world leaders in the field, is already one of the few manufacturers that market an 8-bit microcontroller which combines a random-access memory (RAM), an erasable programmable read-only memory (EPROM), and an electrically erasable programmable read-only memory (EEPROM) on a single chip. Its current ST90E40 model manages to combine, on a single chip, a 16-bit microcontroller, originally designed by Siemens (with a 1-kilobyte RAM and a 10-bit analog-digital converter) and a 32-kilobyte flash memory with a 50-nanosecond access time. A first!

Integration of the flash memory instead of the EPROM is of interest for more than one reason. On the one hand, it permits utilization of a plastic housing, which is not without effect on price when one knows that a plastic housing costs 18 times less to produce than a ceramic housing (\$1.50 per 100 pieces instead of \$27). On the other hand, the flash memory allows a program to be changed when an application is up and running. This technology can also be used in manufacturing, e.g., for individual checks of automobile engines.

#### **Threefold Increase of Sales in One Year**

The first prototypes of this ST10F166 model are now being evaluated. It has a RISC-type [reduced instruction set computer] central unit for the instruction execution time (100 ns at 20 MHz for most instructions) and a CISC-type central unit for the number of instructions. The prototypes have been implemented in 1.2-micron CMOS [complementary metal-oxide semiconductor] technology. The first commercial specimens in 0.8-micron CMOS technology are expected for the first half of 1992. However, applications based on 16-bit microcontrollers with or without flash memory are not expected to get off the ground until 1995-96. [passage omitted]



### Belgian Chip Makers Join for Submicron Research

92BR0100 Groot-Bijgaarden DE STANDAARD  
in Dutch 16-17 Nov 91 p 17

[Article: "IMEC [Interuniversity Microelectronics Center] and Mietec Reach Long-Term Agreement—Cooperation Between Research and Manufacturer"]

[Text] Leuven—IMEC, the Interuniversity Microelectronics Center, and chip manufacturer Mietec, a subsidiary of Alcatel, are to cooperate closely in the coming four years on the next three generations of application-specific chips.

According to Professor Gilbert Declerck, director of the advanced semiconductors department at IMEC, the agreement is a typical example of cooperation between an institute for basic research (IMEC) and a manufacturer (Mietec). This year, some 600 million Belgian francs [Bfr] of IMEC's budget of approximately Bfr1.4 billion was generated from revenues of research results carried out for industry.

For Mietec, the only chip production unit of the telecommunications group Alcatel, cooperation with IMEC is the final phase of a recently announced Bfr4 billion investment plan for a plant in Oudenaarde where next-generation chips are to be produced.

Both parties believe that cooperation will result in the fusion of the best of both worlds: leading-edge production technology of IMEC's laboratory environment and the rather conservative but more application-oriented Mietec technology.

The agreement requires substantial means and people. It will involve 20 to 30 man-years annually over the four-year period of the agreement, according to IMEC Managing Director Roger Van Overstraeten.

Development of the production process consists of three phases: First, researchers will work on the basic steps of the process; then they will combine these modules to form a process; and in the third stage they will produce a prototype. The researchers are to start the development of production technology for a 0.8-micron chip. However, the agreement also stipulates that the first research phase for the next-generation chips—even smaller 0.65- and 0.5-micron chips—is to be started up during the third research phase of the 0.8-micron chip technology.

Chip production, as stipulated in the cooperation agreement between Mietec and IMEC, takes place on a submicron level: The patterns etched on the chips are smaller than 0.001 mm.

These are so-called ASIC's [application-specific integrated circuits], chips for special applications such as telecommunications and high-definition television. This is an area where Europe still has an important role to

play, says Van Overstraeten. Japan is leader in the field of memory chips whereas the United States leads in microprocessors.

The significance of ASIC's will increase in the next few years, according to market forecasts. In 1994, ASIC's are expected to represent ECU17 billion (Bfr714 billion) of the total sales revenue of chips worldwide which amounts to ECU60 billion (Bfr2,520 billion). Mietec ranks ninth among worldwide manufacturers for a particular type of ASIC, namely the standard cell IC. The company is the second manufacturer in the world of the mixed analog/digital chip type.

### Belgian Universities, Industry Cooperate on Chip Production

92BR0126 Antwerp DE FINANCIËLE-  
EKONOMISCHE TIJD in Dutch 16 Nov 91 p 13

[Article: "IMEC [Interuniversity Microelectronics Center] and Mietec Work Together on Chip Know-How"]

[Text] The Interuniversity Microelectronics Center (IMEC) signed a four-year cooperation agreement with Mietec, the Flemish manufacturer of custom-made chips which is part of the Alcatel group. The purpose of the agreement is to develop "preindustrial know-how" for the 0.8-micrometer CMOS [complementary metal oxide semiconductor] process which will be used for Mietec's new production line.

Mietec recently started the construction of a second chip factory, in which next-generation submicron chips (0.8-0.5 micrometer) will be manufactured. Both parties add that: "The contract also forms the basis for future cooperation in developing the next generation of processes (0.65 and 0.5 micrometer)."

Due to the exponential growth of the number of components per chip, constant attempts are made to reduce the transistors' dimensions, resulting in lower cost per function, in increased throughput, and in reduced power consumption.

At present, IMEC's research activities in the field of process development are therefore focused on submicron CMOS technology with dimensions below 0.001 mm. IMEC developed its own 0.7-micrometer CMOS technology, which can be fully integrated and which can be downscaled to smaller dimensions (down to 0.5 micrometer). This is considered unique in Europe. The provisional goal is a 0.5-micrometer CMOS process, which will enable IMEC to manufacture prototype chips containing half a million transistors, while providing an acceptable output.

IMEC was formed in Leuven in 1984 by the Flemish Government in order to consolidate the industrial activities in the field of microelectronics in Flanders. At present, the center employs some 450 people. Its budget for 1991 amounts to 1.4 billion Belgian francs [Bfr].

Mietec was formed in 1983 by Alcatel Bell, the leader in European telecommunications, and by the Regional Investment Company for Flanders (GIMV). Since 1990, Alcatel owns all of Mietec's shares. Within Alcatel, Mietec is the only production unit for chips. At present, Mietec has 400 employees and its sales revenue amounted to BFr2.8 billion in 1990.

### **JESSI Streamlined, Abandons 64 Megabit Chip**

92P60112 Duesseldorf *HANDELSBLATT* in German  
17-18 Jan 92 p 6

[Text] After 18 months, the European microchip program is entering its main phase in a decidedly streamlined fashion, stated FRG Minister of Research Heinz Riesenhuber (CDU) before the press. The originally 80 projects have been condensed into 20, and thus new accents have been set, he said.

Development work on the 64 megabit chip is no longer being supported, since Siemens has joined with IBM to do this, said Riesenhuber. The German side had set aside subsidies in the amount of 30 million German marks (DM), which were spread over six years. In JESSI's most important projects, European companies are working on integrated circuits for high definition television (HDTV), digital radio, and mobile radio. The total program costs DM8 billion, which the companies and the government are sharing equally. Besides the Federal Republic of Germany, such countries as France, Great Britain, the Netherlands, and Italy are involved, among others.

Riesenhuber stressed that European companies are not able to cover the entire spectrum of microelectronics. Rather, these companies must engage in international cooperation.

### **Germany: High-Temperature Superconductor SQUIDS Ready for Mass Production**

92WS0133A Frankfurt/Main *FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT*  
6 Nov 91 p 8

[Text] FRANKFURT—The Research Society for Information Technology mbH, Bad Salzdetfurth, has developed a quantum interferometer, which contains a high-temperature superconductor, that is now ready to be mass-produced. The first of these magnetic field sensors, called SQUIDS for short, will be used at the Hamburg-Harburg Technical University. Unlike the currently used deep-cold SQUIDS, they need only be cooled with liquid nitrogen, thereby making their operation somewhat simpler and more economical. However, the manufacture of these small  $300^2$   $\mu\text{m}$  sensors is more difficult, the company reports, and the technical values are not up to those of the conventional superconductor SQUIDS.

During production, a tablet of superconducting materials is vaporized by a laser beam and precipitated onto a special carrier plate. In the next step, the coarse

structure of the sensor is etched out. For the SQUID to function, the superconductance has to be suppressed on one or more spots on the component. These weakly superconducting spots are  $0.3 \mu\text{m}$  long and  $3 \mu\text{m}$  wide. The Research Society achieved this by means of bombardment with oxygen ions. In the process, the properties of the material are deliberately altered at a length of only 1000 atomic positions.

Even though the new high-temperature SQUIDS are not as sensitive as their older deep-cold competitors, which have had about a 15-year lead in development, there will be enough uses for them in any case, according to Professor Dr. Eng. Johann H. Hinken. They could be used in all situations where small magnetic fields have to be measured, but where the greatest possible accuracy is not required. It would be possible, for example, through measurements of the magnetic field with these sensors to detect invisible errors in weakly magnetized materials like high-grade steel. They could also be of help in geophysics in prospecting ore deposits.

### **Multichip Module Project Launched Under EUREKA**

92BR0152 Paris *ELECTRONIQUE INTERNATIONALE*  
HEBDO in French 12 Dec 91 p 26

[Article by Frederic Fassot: "ECU 18.3 Million for Multichip Technology"]

[Text] Thirteen European companies are associated in a EUREKA project for the development of design and manufacturing technologies for multichip modules used in civilian applications.

A global approach to multichip technology is the task in which 13 European companies or organizations will be involved during a three-year EUREKA program representing an amount of ECU18.3 million (about 140 million French francs [Fr]). The project is on a par with the market forecasts for multichip modules: A recent study of the British Department of Commerce and Industry estimates that the world market will be \$6 billion by 1995. Meeting last week in Abington on the premises of TWI [The Welding Institute], the leading British company the PEPITE (Performance Packaging and Interconnection Techniques) program, the participants lifted a corner of the veil on the studies they were to conduct.

### **Creation of Seven Work Groups**

Seven work groups will deal with all aspects of multichip technology: substrates, thermal aspects, chip mounting, interconnection technologies, protection of modules, tools for thermal and electric modeling, and, finally, the design tools. Although the participants in the PEPITE program admit that some European companies already have experience in multichip modules, they would nevertheless like to go back to square one for all the solutions so that, according to them, effective operation

of the multichip modules is rendered possible by surmounting the performance barriers inherent in the current interconnection and packaging technologies. The objective is development of the technologies which make it possible to obtain reliable modules for applications in telecommunications, information systems, consumer products, and industrial electronics.

Four French companies participate in the project: SAT (leader) [Telecommunications Corporation], Sorep, ES2 [European Silicon Structures], and Racal-Redac TAD (part of the Racal-Redac group following purchase of Thom'6 in June 1989). The French group contributed Fr61 million to the project. The team is completed by the Finnish Nokia, the Swedish Saab-Scania Combitech, and seven British companies (BNR Europe, the interconnection division of Northern Telecom, Newmarket Microsystems, Racal-Redac, Johnson Matthey, Gwent Electronic Materials, TWI, and the University of Warwick).

The PEPITE project will thus have access to the know-how of materials suppliers, manufacturers of interconnection substrates and chip assembly, suppliers of design tools, as well as potential testers and users of these modules.

The PEPITE project skips silicon substrates, which are covered by a JESSI [Joint European Submicron Silicon Initiative] project, and concentrates mainly on ceramic substrates and the printed-circuit-type laminates. The purpose is to propose solutions meeting the requirements of low-noise, high-frequency applications (in excess of one GHz) for telecommunications and personal communications systems as well as low-cost solutions for power applications in automobiles. The developed design tools will also have to be adapted to multichip modules with silicon substrates; links to the JESSI project will be encouraged.

#### Substrates for Three Types of Applications

The goal of the "Substrates" work group is development of substrates for three types of applications: high-density/high-power, high-frequency, and reliable low-cost applications. Inorganic dielectrics in the form of screen printable pastes and cofired [dielectric material] will be studied with a view to obtaining products with a dielectric constant of the order of 3.8.

Moreover, organic compounds will be examined to replace, in particular, the laminated "FR4" products.

All the technologies in the field of interconnection will be evaluated (wire bonding, TAB [tape automated bonding], flip chip). Interconnection of chips on flexible circuits will also be studied.

For protecting chips and modules, the work group will study sealed packages organic and mineral coatings, and utilization of low-temperature cofired materials. In the latter case, cavities can be made in the substrate so that the active compounds can be embedded in them.

In the field of CAD [computer-aided-design] software, Racal-Redac will be in charge of the development of a design software for high-density interconnection that will take into account heat parameters and the effects of high-frequency applications.

#### Siemens Develops High-Speed Microelectronic Component Insertion Device

Frankfurt/Main FRANKFURTER ZEITUNG/BLICK  
DURCH DIE WIRTSCHAFT in German  
16 Dec 91 p 10

[Article by "re": "More Feed Tracks Increase Flexibility; Siemens: New Insertion System Places Up to 39,000 Components an Hour"]

[Text] Siemens AG, Munich/Berlin, has introduced a series of new insertion machines for the surface assembly of components on printed circuit boards. According to information provided by the company, the Siplace 80 S is a modular, high-power insertion system that uses one to three insertion stations to achieve maximum insertion rates of 13,000, 26,000, and 39,000 components per hour. In addition, flexibility has reportedly been increased through the number of feed tracks. There are now 80 8mm tracks per station, and thus up to 240 tracks for the three stations. Besides components from belts, it is also possible to process components from bar stock carriers and in bulk. Should retrofitting prove necessary, this can reportedly be done in a few minutes, thanks to interchangeable tables for the component feed modules.

The machine operates according to the following principle: The printed circuit board and the component feeds are stationary during the insertion process. Two turret insertion heads on a double-gantry axle system proceed from the component feeds to the circuit board. Because the circuit board is stationary, larger or cylindrical components in particular cannot shift or slide, Siemens reports.

The stationary component feed reportedly provides precise pickup positions and moreover allows additional components to be fed in during the insertion process. While one turret head is picking up components with its 12 suction pipettes, the other is inserting components on the circuit board. After insertion, the first head returns to the component feed to pick up new components, while the other head inserts the components that it has previously picked up. Since component feed tracks are positioned on both sides of the circuit board, continuous insertion is possible without having to take into account time lost through the component pickup process.

A new, integrated vision system for determining the position of circuit boards and components reportedly ensures precise insertion. Also included in the system is a measuring device to check all dipolar components (capacitors, resistors, diodes, and inductors). Siplace 80 can be easily linked to the widely distributed HS-180 and SP 120 Siemens insertion systems.



### German Research Minister Comments on Revised JESSI Program

92MI0250 Bonn WISSENSCHAFT WIRTSCHAFT POLITIK in German 22 Jan 92 p 2

[Text] JESSI [Joint European Submicron Silicon Initiative] has now entered a phase of intense activity. A total of about 8 billion German marks will have been spent on this ambitious EUREKA [European Research Coordination Agency] program by the time the funding period comes to an end in 1996, the aim being to bring together the entire microelectronics research potential available in Europe and to direct it towards strategic goals. It is planned to devote 3,400 man-(or woman-)years to giving Europe the hoped-for boost in this technology of the future.

Following the initial phase, nearly 80 individual projects have been reorganized and streamlined into 20 "flagships," emphasized Federal Research Minister Heinz Riesenhuber late last week in Bonn. As a result, "independently operating firms involved in chip production, chip application, and tools for chip production are engaged in joint cross-border work within the flagships." In this way, maintains Riesenhuber, JESSI is promoting a self-contained microelectronics research region in Europe.

The largest flagships are geared towards applications that, it is currently predicted, will achieve considerable market importance towards the end of the 1990s. These include the development of circuits for future high-definition television (HDTV), digital radio reception, or mobile radio phones. It was high time for their launch.

### JESSI To Focus on Telecommunications Technology

92WS0260D Duesseldorf VDI NACHRICHTEN in German 27 Dec 91 p 1

[Unattributed article: "Flagship Projects Clarify JESSI's Direction: To Date DM930 Million Have Been Invested in the Chips of the Future"]

[Text] Duesseldorf, 27 DEC (VDI-N)—The two-year initial phase of the European Microelectronic Program JESSI (Joint European Submicron Silicon) ends at the end of this year. Consequently, the JESSI board is currently taking stock: During the initial phase, approximately 3,000 man-years of sci-tech work was performed in more than 120 companies.

Research fields were chip technology, devices and materials, applications and systems, as well as basic research in the field of microelectronics. The funds spent for this amounted to approximately 930 million German marks [DM]. Approximately half of that came from industry, 40 percent from national governments, and only roughly 10 percent from the EC.

The experiences of the initial phase resulted in a fundamental restructuring of the program for the main phase

which begins on 1 January 1992. The focus of the new design is a number of so-called project clusters consisting of several related individual projects. A so-called flagship should illustrate the direction of the projects. The entire program is simultaneously tightened up and more clearly directed towards immediate applications. The core fields of future activities are chips for high-definition television HDTV, digital sound radio, broadband ISDN, and cellular mobile radio as well as electronics for increased auto safety.

JESSI's budget for next year—more than DM800 million—has already been adopted within the framework of an agreement between the companies participating in JESSI, the national governments, and the EC.

### Recent Developments in Selected ESPRIT Research Projects

92WS0270A Brussels EUROPEAN STRATEGIC PROGRAM FOR RESEARCH AND DEVELOPMENT IN INFORMATION TECHNOLOGY PROGRESS AND RESULTS in English 1991 pp 15-39

[Selected articles on microelectronics and information processing systems contained in ESPRIT 1990/91 PROGRESS AND RESULTS published by the Commission of the European Communities]

[Text]

### Overview

#### Objectives

The Microelectronics (MEL) activities of the ESPRIT programme concentrate on stimulating the creation of the design tools, process technologies, equipment and support industries required by European electronics goods manufacturing companies to create their own integrated circuits (ICs) tailored for specific uses—the so-called application-specific integrated circuits (ASICs). ASICs are a more efficient and cost-effective alternative to purchasing standard, non-optimized components.

Sales of electronic systems amounted to ECU630 billion world-wide in 1990 and consumed ECU77 billion worth of microelectronic components, including ASICs, which currently make up about 30 percent of the world IC market. Microelectronics provides the technology foundation for information technology (IT) and telecommunications, and has extended its impact far beyond these sectors, representing a significant source of added value in a growing range of products, ranging from toys to telephones and word-processors to washing machines. The competitiveness of Europe's IT industry depends on its early mastery of microelectronics, and this means gaining fast access to emerging technologies at the definition stage and being able to incorporate them into future generations of products.



### Trends

The key to success in the IT market as a whole—and in the microelectronics sector in particular—is the rapid update of technologies, as the industry is marked by a high rate of product innovation, leading to ever-shorter life-cycles of increasingly 'intelligent' products. Microelectronics companies have to invest on average 16 percent of their sales in R&D compared to 10 percent in the IT industry overall and 3 to 4 percent in the aerospace, automotive and chemical sectors. Furthermore, with capital investment running at around 20 percent of sales, the total investment in a new technology is comparable to the total revenue accrued from the previous generation. Hence both firms and governments invest substantially in R&D. Cooperation between competitors at the level of pre-competitive R&D allows the growing costs of research to be shared, spreads the risk of new ventures, and fosters the industrial restructuring required to give companies the chance of a significant presence in global markets.

During 1990 there were a total of 64 ongoing microelectronics projects. Seven projects were completed. The industrial character of the programme has been stressed through the launch of several demand-driven projects, with specific attention paid to the establishment of cooperation between manufacturers and users.

### Community Participation in JESSI

The background to the present participation of the Community in JESSI lies in the shared strategic purpose of the microelectronics actions within JESSI and ESPRIT. Both aim to consolidate the traditions of microelectronics in Europe to the benefit of systems houses of all sizes. The main difference between the two strategies is that ESPRIT, by its very nature, is precompetitive, addressing a broad range of technologies in order to cover the very varied spectrum of needs in the Community; while JESSI, in line with its inclusion in the Eureka programme, is more strongly market-oriented and has advanced CMOS technology as its focus. In the area of sub-micron CMOS technologies, there is thus a great potential for fruitful collaboration between the ESPRIT and JESSI programmes. The participation of the Community in JESSI will be in those activities which, by virtue of their characteristics, expected benefits and particular participants, are best carried out at Community level.

Provision has been made for effective exchange of technology and results between ESPRIT and JESSI projects, which extends to organizations in countries currently outside the JESSI programme.

### CAD and Design Methodology

Computer-aided design (CAD) is one of the key enabling technologies needed to support the electronics systems and components industries. It is also the basis of a

self-supporting industry which, until now, has been dominated by a small number of US-based companies. However, the market in Europe is currently expanding more rapidly than elsewhere, and there is evidence that the investment in CAD over recent years is starting to pay off. From a total of 28 CAD projects in ESPRIT, 68 firm commercial results have been reported. Of these, 62 percent contribute directly to products or services, 26 percent relate to tools and methods, and the rest have made contributions to international standards. Some of the more important results are detailed below.

SNI [Siemens-Nixdorf-Informationssysteme] (D), which has emerged onto the world electronics CAD scene with the SIGRAPH-EL product, is already selling the CALANY floor-planner tool resulting from AIDA (project 888). Help for IC designers: using the macrocell design techniques and tools developed in AIDA (project 888). Siemens has produced a 32-bit coprocessor for automation systems, pictured here [photo not reproduced], that integrates more than 300,000 transistors. As VLSI circuits become more complex, CAD techniques, software tools and design methods must advance to match them. AIDA has extended the capabilities of a wide range of individual CAD tools so that tools for different tasks, developed in different companies, can be used in combination. A notable feature of the AIDA system is the incorporation in the IC designs of built-in test modules which make it possible to test the manufactured chip at a much lower cost than before. CALANY gives cost improvements resulting from a reduction of 50 percent in total block area and performance improvements of up to 35 percent in total wire length.

Anacad Computer Systems, a small German company arising from CVS (project 802), has signed an agreement with SGS-Thomson Microelectronics (F) to supply more than 300 copies of ELDO, their high-precision, high-speed analogue simulator, for integration with SGS-Thomson's MOZART multi-level digital simulator, also partially developed in CVS.

The latest mainframe computer from Bull, the DPS 7000 series, is the most powerful in Europe, capable of more than 220 transactions per second and of handling up to 4,000 terminals. The 11 VLSI chips used (with up to 500,000 transistors per chip) were all tested using the CATI system which Bull developed in collaboration with other companies in EVEREST (project 2318) and IDPS (projects 2426 and 5075). The fault-diagnosis tools made it possible to design and test these complex chips without any increase in cost or time compared with the previous chip generation.

Cryptech, a small Belgian firm, has developed a single-chip hardware implementation of the DES encryption algorithm. It is being manufactured in Belgium by Mitec. This product gives cheap and easy access to all users of the standard DES algorithm and is proving a major success, helped by its world-beating conversion speed (in excess of 18 Mbit/s). Cryptech used the

CATHEDRAL design methodology, transferred with the help of IMEC (B) from the results of projects 97 and 1058.

SGS-Thomson Microelectronics (F) has demonstrated the capabilities of the CAD tools developed in CANDI (project 2268) by designing and fabricating a colour decoder chip that can decode digital luminance and chrominance to analogue RGB signals. The prototype will be used in the 1,000 HDTV sets supplied for the forthcoming Olympic Games in Barcelona.

#### **CAD Standards and Infrastructure**

ECIP (project 2072) is paving the way for internationally accepted standards in CAD for VLSI in several domains. The longest established of these is in design data exchange. One of the organizations in the project, Manchester University (UK), in addition to representing Europe on the international EDIF (Electronic Data Interchange Format) Technical Committee, has established an EDIF validation service which satisfies a world-wide demand for checking conformity of data to the new standard.

A new development in CAD standards is the initiative to agree to guidelines for standards in CAD frameworks. Through the initiative of organizations working in JESSI CAD-Frame (project 5082) and in ECIP, significant contributions are being made to this important area. Each technical subcommittee has either a chair or co-chair from Europe, and at least one of the four CFI meetings is held in Europe each year. A first prototype is being demonstrated at the Design Automation '91 conference in San Francisco, alongside other commercially developed prototypes. SNI (D) has announced a product, FrameWare, based on the early results of CAD-Frame.

#### **Validation and Test**

In the drive towards ever-increasing system complexity and with more and more demands on performance, one of the major bottlenecks is in verification and testing. Up to one-half of the final cost of a complex chip or printed-circuit board can be attributed either directly or indirectly to test problems. The strategy for answering this hitherto intractable question is through constraining design methodologies in order to ensure testability. Two projects are attacking this problem in different areas.

The first is 'Research Into Boundary Scan Test Implementation' (project 2478). The effective and efficient testing of chips, boards and systems can be dramatically affected by incorporating the boundary scan philosophy into both standard ICs and ASICs. The project has had great influence on the specification and implementation of world test standards by creating a data model which has been incorporated into the electronic data interchange format (EDIF) as well as strongly influencing the work of the IEEE 1149 test standards committee. Philips (NL), a partner in the project, has decided to commercialize the results and to enter the tester market with a low-cost range of products specifically designed to test

chips, boards and systems equipped with boundary scan. Testing PCBs: the Philips Logic Analyser at the top of the picture [photo not reproduced] has been designed to use boundary scan test (BST) practices, resulting from project 2478, to simplify test and fault diagnosis procedures. The BST technique allows the testing of complex digital printed circuit boards (PCBs), like the one shown, via serial access from the edge connector to the periphery of the integrated circuits on the PCB. This method is much cheaper than conventional electronic testing.

EVEREST (project 2318), the second project in this area, has made a major contribution to the test view of the EDIF standard, where the definition has been led by an international team largely made up of EC members. An example of software which has already undergone successful exploitation is the SPHINX tool. This has already been used to produce several chips, including one containing 120,000 transistors that worked correctly in its first implementation.

#### **Silicon Technologies**

Research activities in this area are mainly directed towards the development of technologies needed for the medium- to high-volume production of consumer, telecommunications and industrial ICs. The work encompasses a wide range of process technologies and is carried out under the headings of five IC process activities:

- core CMOS, for digital applications,
- flexible CMOS, for multifunctional applications,
- bipolar, for high-performance and high-speed digital, analogue and mixed analogue-digital circuits,
- BiCMOS, for fast digital and mixed analogue-digital circuits,
- high voltage.

Provisions are made in the projects to stimulate the take-up of results and to encourage the use of advanced technology by incorporating demonstrators applied to real applications, and by involving qualified users, including SMEs. Links have been established with other CAD, design and library projects in all activities, and the methodologies used pave the way towards second-sourcing capabilities.

#### **Flexible CMOS**

Flexible CMOS technologies are created by the addition of process options to a core sub-micron CMOS process. The building of the core process is currently undertaken in two projects: JOINT LOGIC (project 5080) and ACCES (project 5048).

Three projects—JOINT LOGIC (project 5080), ADCIS (project 2193) and APBB (project 2039)—are building options to these cores to extend the process features to enable low voltage operation (down to 1.5 V), lower power consumption, optimization for embedded memories (DRAM and SRAM), and the inclusion of fundamental analogue components.

Joint logic is a collage of detailed segments from a four-channel digital signal processor (produced by Alcatel-Mietec) destined for telecommunications applications. The combination of analogue and digital circuit elements on the same flexible CMOS chip stems from work in project 5080 (JOINT LOGIC), which brings together the major IC manufacturers in Europe to develop the basic fabrication concept for a competitive 0.5 micron CMOS technology suitable for a broad range of applications. The JOINT LOGIC project is developing analogue and memory options to be added onto a 1 and 0.7 micron digital CMOS process developed in the same project, and a special low-voltage (1.5 V) CMOS process. Micro-controllers, digital signal processors, ICs for smart cards, battery-operated circuitry, composite arrays and applications in the audio, TV, telecommunications and automotive markets are under development.

In the ADCIS project, a 1 micron CMOS process is being adopted and characterized for mixed analogue/digital functions by Mietec (B), Matra-MHS (F) and CNET (E). At the same time, the development of design tools for building a system capable of producing silicon compilers, an analogue cell library and analogue basic converter functional blocks are being developed. The software related to the first version of this CAD tool (block placement, global router, simulation system), mixed layout generators, and specific compilers (analogue/digital/analogue converters) are being commercialized by Anacad Computer Systems (D). In addition, a complex video processor for telecommunication, multimedia terminal and videophone applications is being designed and fabricated.

The APBB (Advanced PROM building blocks) project has achieved the integration of EPROM and EEPROM memory devices into 1 and 1.2 micron CMOS processes (GEC-Plessey (UK) and SGS-Thomson (I)) and into a low-voltage (1.5 V, 2 micron design rule) CMOS process (Eurosil (D)). To exploit the key features of this technology, adequate CAD tools, building blocks for system designers and appropriate test methods have also been developed. Early access to the results has been provided to a number of SMEs to further increase the impact of the project: the resulting collaborations have led to the building of a number of demonstrators, including a gate array with embedded EEPROM, a microcontroller with on-board EPROM and EEPROM, low-voltage ICs for identification applications, an intelligent battery-charger for optimizing NiCd battery life, and ICs for electricity meters, smart cards and musical instrument applications.

### BiCMOS

BiCMOS is a cross-section of the three basic transistors used in project 2430 on sub-micron BiCMOS (bipolar/CMOS). This project has developed a VLSI technology combining high-density CMOS with bipolar circuitry of similar density, but better suited to tasks such as analogue interfacing. Although the performance of BiCMOS processes will always be a compromise between the best bipolar and best CMOS processes, the combination of

bipolar features (analogue parameters, speed, driving capabilities) and CMOS properties (density, memory) creates a very challenging opportunity for many system designers. The BiCMOS market is expected to expand very quickly, with a cumulative annual growth rate of 60 percent from ECU500 million in 1990 to ECU5 billion in 1995—an increase from 1 to 6 percent of the total IC market in only five years.

There are two projects in this field, BiCMOS and CANDI. In BiCMOS (project 2430), Philips (NL) has now completed the development of its 1 micron bipolar CMOS process with double poly, self-aligned n-p-n transistors and a silicide polysilicon emitter, while Siemens (D) has produced the first demonstrators in their 0.8 micron, digitally oriented process with very advanced trench isolation. An advanced demonstrator design, a one-chip video-bandwidth analogue/digital converter with an accuracy of more than 12 bits, has been realized. On the digital side, a 16 kbit ECL-driven SRAM has been made with an access time of only 3.5 ns, one of the best performances achieved world-wide to date.

In CANDI (project 2268), SGS-Thomson (F) and Telefunken (D) have demonstrated the compatibility of their 1.2-micron BiCMOS technology. The aim of this project is to transfer bipolar and CMOS processes originating from other ESPRIT projects. The main result lies in the sophisticated designs using BiCMOS technology for different application areas: an HDTV-RGB decoder, a mobile receiver for cellular networks, and shuffler/scramble circuits for asynchronous telephone networks. A library with more than 100 cells has been created in order to facilitate the use of the technology by systems users.

The next steps in these projects are to extend the processes to wider analogue use; for example, the implementation of vertical p-n-p with the addition of only one mask step. The evaluation and implementation of a RISC 3000 or 4000 processor is planned, as well as a self-calibrating 16-bit resolution analogue/digital converter and advanced FIR filter designs for HDTV.

### BiPolar

BASE, the technology integration project (2016) aiming to develop bipolar technologies, builds on the results of the earlier ESPRIT projects 243 and 281. New transistor architectures have been developed and lateral and vertical device dimensions shrunk in order to meet the requirements for applications such as mobile telephones. The newly developed technology pushes the performance of silicon technology closer to that of III-V technology, but at lower production costs.

In particular, the designs achieved gate delays below 30 ps and significant reductions in power consumption, power delay product and noise. This performance is equivalent to the best results reported in the literature, and is three times better than that achievable by the production technologies presently available.



In addition to the development of pre-production technology, very advanced device structures have been realized. These include a silicon device architecture (BASIC) with minimized parasitic structures, specially suited for optimum analogue performance, and a device structure realized using selective deposition of silicon with a speed performance beyond the specifications for standard technology. Furthermore, bipolar transistors have been fabricated containing epitaxial strained layers of germanium-doped silicon (23 nm thick  $\text{Si}_{0.75}\text{Ge}_{0.25}$  capped with silicon). Although the introduction of these layers in integrated circuits imposes new demands on device architectures and processing, they have the potential to improve speed and noise figures in bipolar circuits fivefold.

The BASE technology has been used by Plessey (UK) to design a 10 Gbit/s 64-1 multiplexer demonstrator for RACE project 1052, and SGS-Thomson (I) has established close collaboration with RACE project 1036 for the demonstration of a 2.5 Gbit/s fibre optic system.

The project partners are the most competent manufacturers of bipolar circuits in Europe, with each partner concentrating on specific optimizations of the technology for speed, complexity, and analogue and digital functionality. These different technologies strengthen the European industrial position in application areas such as consumer electronics (Philips), telecommunications (Siemens), and radio and instrumentation (Telefunken, Plessey). The 1989 world bipolar market of ECU13.6 billion is expected to increase to ECU16.2 billion by 1994.

### High Voltage

In SMILE (project 2272), a high-voltage IC technology suitable for lamp ballast applications has been designed and demonstrated. The devices are combined with low-cost high-voltage packaging technology and are under evaluation to identify any critical behaviour in performance and reliability related to the high voltages involved.

Different types of high voltage devices such as IGBT (insulated gate bipolar transistors), LDMOS (lateral double diffused MOS), and other n- and p-type BJT (bipolar junction transistors) up to 650 V have been integrated on the same silicon chip while remaining fully isolated from each other.

Supporting models for circuit simulation have been generated and parameters extracted. Macro cells comprising a high-voltage bridge driver, control circuits, low-voltage power-supply and start-up circuit, and a high-voltage full-bridge dedicated to lamp circuits have been designed and demonstrated under 250 V operating conditions, showing that a fully integrated solution is practical. A redesigned version is being developed using a 650 V technology which will extend bulb life-time, save energy, and allow features such as dimming and flicker suppression to be added.

The global market for lamp-bulbs is expected to reach ECU30 billion in 1995, of which ECU3.6 billion will be for ballast applications and ECU1.2 billion for electronic components such as those demonstrated in SMILE. In addition, the technology has application in a wide range of sectors such as domestic appliances, industrial controllers, intelligent power supplies and telephone exchange components.

### VLSI Packaging

In order to gain maximum advantage from ESPRIT's technology innovation projects, a complementary improvement is needed in the materials and structures of chip packaging. Two ESPRIT projects are creating compatible packaging and assembly schemes for high pin-count functions as well as accounting for high speed and high reliability needs.

APACHIP (project 2075) covers all areas of packaging, ranging from high density chip assembly and interconnection using very fine substrates, to packaging and testing for high-density, high pin-count applications for advanced VLSI circuits. These products cover both packaged electronic assemblies (multi-chip modules) and packaging material supplies needed for tape automated bonding (TAB) and ceramic-based packages. In packaging for high performance APACHIP (project 2075) employs a multi-chip mainframe computer module from Siemens-Nixdorf which uses a high-density organic substrate with 16 VLSI and 32 LSI devices mounted by tape automated bonding (TAB). The VLSI devices are 12 mm square and have 316 input/output connections. As well as packaging techniques, the project covers the development of high-density, high-performance substrates, a new connector concept, reliability aspects, and new inspection methods. Major results achieved so far include:

- Success in producing TAB tapes with 316 input/output leads at a pitch of 125 micron on 70 mm tape; today MCTS (F) can supply this in industrial quantities.
- Bull (F) developed bonding equipment and processes that include lead-forming and bonding of both inner and outer leads at 125 micron pitch, with 12 mm ICs on 70 mm tape, onto multi-chip substrates. Bull has also established the different process steps for a multi-layer polyimide-copper substrate technology as the basis for multi-chip modules with up to five metal layers on a 10 cm square co-fired ceramic substrate (100 micron pitch of tracks and via holes).
- Hoechst Ceramtec (D) has demonstrated improved fabrication technology and realized a number of new packages, notably a single-chip package with multi-layer metallization, a pin grid array with improved heat transfer (using a tungsten-copper insert), a pin grid array with inner lead pitch of 200 micron, and a 10 cm square multi-chip package substrate containing 888 connector pads.
- High-density organic multi-chip substrates have achieved world-class specifications in terms of low



resistance conductor tracks at pitches down to 80 micron, via holes as small as 30 micron in diameter, controlled impedance tracks, and up to 17 metal layers (signal and power/ground). The aim is to exploit this track definition capability to build complete mainframe central processor units on a single substrate requiring fewer layers.

- Extensive thermal modeling has led to the successful development of several water-cooled and air-cooled demonstrators. The multi-chip modules of Siemens, Bull and Hoechst Ceramtec, described above, have been used in evaluations of thermal and mechanical characteristics.

PLASIC (project 5033) is providing guidelines on how to build, model and evaluate plastic packages for VLSI devices in telecommunications, industrial control and automotive applications requiring high reliability. This project provides the major submicron integration technology projects with a low-cost high-reliability packaging route.

### Compound Semiconductor Technologies

III-V compound semiconducting materials offer a unique range of very attractive properties; low power consumption, high operating speed and the ability to process both optical and electrical signals. Materials such as gallium arsenide (GaAs) and indium phosphide (InP) are suitable for analogue, digital, mixed analogue-digital and optoelectronic applications.

### Microwaves and Millimetre Waves

The market for GaAs microwave and digital ICs is expected to grow world-wide at a rate over 50 percent per year to reach over ECU1.2 billion by 1994. This growth is mainly concentrated in the computer, automotive, communications and broadcasting sectors of the market.

Five ESPRIT projects were launched in 1990 to address applications in the automotive, mobile communications and direct broadcast by satellite (DBS) areas. The current total of six projects make up a comprehensive programme on compound semiconductors for microwave and millimetre applications in the 1-60 GHz range.

Among these, AIMS (project 5032) is focused on applications between 20-30 GHz for short-hop land links and very small aperture satellite terminals. A range of generic monolithic microwave ICs are being developed covering transmit/receive switches, low-noise amplifiers, non-linear circuits, voltage-controlled oscillators and solid-state power amplifiers. The project has already demonstrated hetero-junction field-effect transistors (HFETs) with world-class noise figures and power capabilities. III-V device is a very advanced hetero-junction field-effect transistor (HFET) structure developed in AIMS (project 5032). The device has achieved world-class performance and is suited for applications involving very small aperture satellite terminals. AIMS is one of the core projects in ESPRIT's research into low-cost III-V based MMICs (monolithic micro/millimetre wave ICs) and appropriate CAD tools and manufacturing processes.

COSMIC (project 5018) concentrates on components for applications between 1-20 GHz. On the L-band, the key demonstrators are trans-impedance amplifiers for optical receivers and RF amplifier/mixer monolithic microwave ICs (MMICs) for mobile communications, global positioning by satellite applications and broadband ISDN. On the X-band, MMICs are targeted at the highly competitive market of DBS receivers. On the K/Ku-band, ICs are being developed for point-to-multipoint communications. State-of-the-art results have already been obtained, such as the novel self-aligned high electron mobility transistor (HEMT) process implemented by Siemens (D) for devices with sub-micron gate length, the 2D noise FET (field-effect transistor) model established by Politecnico di Torino (I), and the on-wafer noise measurements achieved by Argumens (D).

GIANTS (project 2035) investigates a number of advanced InGaAs-based FETs for microelectronic and optoelectronic applications. The project has already met its objective of generating a secure European source of InGaAs-based FETs. Picogiga, a Paris-based SME participant, is gaining a global presence in the field of MBE-grown epi-wafers through making significant improvements in its MBE material. Important results have been obtained in quasi-2D modeling for device and circuit design. A software package, HELENA, has been developed by Universite de Lille (F) and is being commercialized.

Besides this technology development work, two projects are focused on the development of very advanced III-V material deposition equipment. PLANET (project 5003) addresses high throughput, multi-wafer MOVPE reactors suitable for growing hetero-structures such as GaAs lasers and InP waveguides, and has already delivered a new 7" x 2" device to European user companies. This project is expected to further strengthen Europe's world-leading position by building on the results of ESPRIT projects 927 and 2518, which are currently being commercialized by Aixtron (D).

Today's safety and environment requirements are the concern of MORSE (project 5031). This is investigating the very promising MOMBE growth technique for the industrial production of III-V devices, and is also looking at the development of novel non-toxic precursors. Tributyl phosphine (TBP), a replacement for the more toxic phosphine, is now routinely used in this project to fabricate state-of-the-art optoelectronic devices.

### Optoelectronics

The optical properties of InP make it the material best suited for long wavelength optical communications. The main application area is in the data-processing, communications, industrial and automotive sectors, where the market is forecast to double to ECU5 billion by 1995.

Significant advances have been made under OLIVES (project 2289) in the technologies of holographic optical elements, low-loss waveguides, optical modulators,

receiver arrays and component mounting for applications in optical interconnections for VLSI and electronic systems. A variety of demonstrators have shown first-class results:

- Using chip-level region-to-region optical clock distribution produces a sixfold increase in clock speed. A simulation of a 1,000-node neural network shows the technique can offer a performance gain of two orders of magnitude.
- Reduction in the volume occupied by the interconnection medium, increased flexibility in the interconnection topology, and, at high data rates, an increase in the density of interconnections.
- Hybrid integration of optoelectronic components and silicon circuits, as demonstrated on a 64 MQW modulator array. Assessment of the performance of individual hybridized elements on the same design has shown the best reported results for long wavelength refractive devices.

Project 263, completed in December 1989, has greatly contributed to the establishment in Europe of technologies with applications in optical communications. These technologies are already being exploited under the RACE programme, where high-quality lasers, optoelectronic ICs and low-loss waveguides are being applied in a range of communications systems and also in optically switched networks.

#### **Manufacturing, Process Equipment and Materials**

New technologies, no matter how advanced or innovative, cannot be exploited unless efficient manufacturing methods are employed. The manufacturing process has two main aspects: the materials support (machinery, facilities) and the logistics of their organization (automation, CAM, etc.). The optimization of the overall production process in order to maximize yields and reduce unit costs is the subject of manufacturing science. In recognition of its vital importance, an ambitious project, 'Manufacturing Science and Technology' (project 5081), grouping together all the major European IC manufacturers, was launched in 1990. Europe has a strong position, world-wide, in materials for semiconductor manufacturing (process gases and chemicals, resists, wafers, etc.), while it is relatively weak in the domain of equipment, with only a 10 percent world market share in the area of wafer processing.

#### **Lithography Equipment**

ESPRIT provides comprehensive coverage of all the main aspects of advanced lithography. This includes equipment, materials and the related processes for deep-UV steppers—E-beam lithography, and reticle processing and handling.

A wafer-stepper is one of the most strategically important pieces of equipment for IC manufacturers. At present, minimal feature sizes in production are in the 0.7 micron region, and are expected to reach 0.35 micron

by 1995 in state-of-the-art memories, with ASIC applications following close behind. New techniques will have to be developed for lower ranges. The most promising is the use of deep ultra-violet (DUV) light, but this poses formidable problems, principally in the areas of lens optics, alignment precision, and resist materials. All these aspects are being very successfully tackled in DEEP-UV (project 2048). A prototype stepper was fabricated at ASM-L (NL), with a lens made by Carl Zeiss (D) incorporating some unique features, such as through-the-lens alignment. The system demonstrated record-beating performance in resolution, alignment accuracy and throughput, and is the most advanced stepper of its kind in the world. Several units based on this prototype have been sold to IC R&D facilities around the world.

Complementing this work, single and multi-layer DUV-specific resists have been developed by Hoechst and Siemens with the close cooperation of IC manufacturers. Evaluation of the results of these projects is being performed by IMEC (B) and LETI (F), who have both acquired DUV steppers. DRYDEL (project 2265) is extending DESIRE, a single-layer resist technique, to cover the deep-UV region, whilst in the reticle generation area FREE (project 5030) has been recently launched.

#### **Multi-Process/Multi-Chamber Equipment**

The increasingly stringent constraints on the quality of the thin films constituting ever more miniaturized ICs demands a new trend in wafer processing: the grouping together of related process steps and their sequential performance in several clustered vacuum-processing and transfer chambers. It is estimated that with feature sizes of 0.5 micron and below, the use of multi-process/multi-chamber vacuum-sealed equipment will be a necessity for certain critical process steps. This approach requires new equipment designs and the development of modified or new processes.

During the first phase of MCBRIDE (project 2403), which includes ASM-I (NL), LETI (F) and SGS-Thomson (I), a prototype multi-chamber reactor has been developed which allows the deposition of inter-poly ONO (oxide-nitride-oxide) films in a single integrated wafer-processing system. This equipment is suitable for the most sophisticated EPROM and EEPROM devices, and non-volatile ASICs. With feature sizes of 0.5 micron and below, the use of multi-chamber/multi-process vacuum-sealed equipment will become a necessity for certain critical process steps. This first prototype (consisting of a high-frequency cleaning module, LPCVD and oxidation reactors plus wafer handler and elevator units) has been installed at LETI for further testing and evaluation. Complementary work on process characterization and preliminary engineering of the next version of the reactor are in progress at ASM-I.

In support of MCBRIDE, PROMIMPS (project 5041) was launched in 1990 involving equipment manufacturers, users, and three research institutes. The objective

of the project is to realize the integration of different processes in multi-chamber 'cluster' tools. The application areas chosen are silicide metallization, CVD blanket deposition of tungsten, and inter-metal dielectrics.

### Manufacturing Science

The completion of AMS (project 1551) in December 1990 has led to the participants obtaining attractive solutions to IC manufacturing problems, particularly with respect to contamination control and yield improvement as well as in interfaces and communication protocols for IC production equipment. Further collaborative work of a more advanced nature in process automation is now being undertaken within 'Manufacturing Science and Technology' (project 5081) using as a basis the know-how developed in AMS. The project participants, all of them IC manufacturers, are examining each step in the IC manufacturing process in order to increase the cost-effectiveness of their VLSI manufacturing operations. The project is producing common recommendations and standard guidelines for process equipment and materials manufacturers that will also enable the latter to improve their products.

### Accompanying Measures

Microelectronics activities in ESPRIT also aim to stimulate awareness through the dissemination of information and the encouragement of new users, in particular SMEs. This goal is being addressed in four ways:

- by increasing user participation in technology demonstrators (for example, SME participation in the APBB project);
- by three special actions targeted at the more peripheral regions of the Community;
- within the concerted technology access for SMEs (CTA-SME) special action;
- through encouraging participation in Special interest groups (SIGs).

### Special Actions

Following the evaluation of the 1989 call for proposals, it was apparent that specially tailored actions were needed in certain peripheral regions, notably Spain, Portugal and Greece, in order to promote the level of awareness and industrial application of microelectronic technologies.

In 1990-1991 the first phases of GAME (Spain, action 5083), AICI (Portugal, action 5691) and VLSI-DPE (Greece, action 5692) were launched. Each was set up after close consultation with the respective national administration and aims to:

- encourage links and the transfer of technology from other ESPRIT microelectronics actions or projects in order to bring the organizations concerned into closer involvement with the European microelectronics R&D community;

- build on and mobilize existing resources, both intellectual and material, in the countries involved;
- promote local cooperation between research institutes, academia and industry with the objective of enabling local industry to better benefit from existing local know-how.

In the first year of operation, considerable success has been achieved in terms of mobilizing existing resources, and some 50 ASIC projects, predominantly involving first-time users, have been initiated. The application of ASICs has become a common (but not the only) theme of these actions. Additional activities in high-voltage smart power, gallium arsenide and integrated sensor technologies are also under way.

### Concerted Technology Access for SMEs (CTA-SME)

ASICs are considered to be key to the competitiveness of European companies, especially small and medium-sized industries. However, it has been estimated that only around 2,000 of the estimated 25,000 SMEs in the Community have incorporated ASICs into their products, mainly due to a lack of awareness and training.

Measures designed to encourage SMEs in the use of microelectronic technologies are taking place or being planned in several member states. CTA-SME (action 5084) plans to generate links between these initiatives (including the ESPRIT special actions described earlier) in order to bring about closer collaboration and the cross-fertilization of ideas.

In addition to convening workshops and setting up training activities, the pilot phase of CTA-SME is preparing (in collaboration with the relevant member state programmes) technology transfer packages covering training aspects, documentation, design tools, component libraries, etc., and information on the market analysis, economic assessment, design and fabrication of ASICs. Initially drawing on the results of existing ESPRIT microelectronics projects, these packages will be made available to SMEs and national SME service centres throughout the European Community.

If the pilot phase, after independent evaluation, is found to have been successful, the Commission will propose the launch of a five-year action with the aim of making available a wide portfolio of emerging technologies (such as BiCMOS, non-volatile CMOS ASICs, smart power and GaAs, etc.) to the large number of European SMEs that could, as recent surveys indicate, incorporate ASICs and other microelectronics components into their products and so gain a competitive advantage in the global information technology market.

### Special Interest Groups (SIGs)

There are now six SIGs operating in the microelectronics area. These groups have generated many reports, guidelines and ad hoc inter-company standards in addition to acting as a forum for the exchange of ideas and results. SIGs create the fertile conditions in which potential



future ESPRIT projects are conceived. In addition to the four groups that have been operational for several years, two new ones were launched in 1990, covering reliability and analogue design issues. The SIGs currently supported are:

- CAVE (CAD for VLSI in Europe),
- VLSI manufacturing automation and standards,
- Lithography,
- Analogue circuit design,
- Reliability,
- Electronic materials.

Further details are given in the chapter on awareness activities.

## INFORMATION PROCESSING SYSTEMS

### Overview

The Information processing systems (IPS) area of ESPRIT aims to provide a selected range of generic technologies that are critical for the development of IT products likely to come onto the market in the 1990s. The generic nature of these technologies makes them applicable to a wide range of system products, offering a real advantage to vendors and providing high value to users.

The main objective of IPS is to produce more powerful and reliable systems at an affordable cost by supporting projects in four key sub-areas:

- Advanced system architectures,
- Information servers,
- Systems design and engineering,
- Signal processing systems.

Forty-one new projects and 17 exploratory actions were launched as a result of the general call for proposals that closed in January 1990. The competition for projects was particularly strong in IPS, which received 220 proposals, half of the total submitted. This clearly indicates that European enterprises, and in particular SMEs, continue to demonstrate an appetite and a drive to invest in the development of advanced technologies that are seen as a critical source of future revenues and competitiveness.

In the course of the past 18 months, four important trends have been apparent:

- Continuing commercialization of earlier results

A market is now developing for the high-performance parallel computer systems explored and developed in a number of earlier ESPRIT projects, and this has been matched by the emergence of an increasing number of European suppliers, mostly small but all now experiencing a period of rapid growth. New software products are reaching the marketplace, such as commercial implementations of the Portable Common Tool Environment (PCTE). In addition, European knowledge-based system products and companies show a sharp increase in their

share of a world market estimated to exceed ECU20 billion by the end of decade.

- Intensified standards-related activities

In all sub-areas, major projects are tackling the issue of establishing standards in order to increase the range of choice available to end-users while lowering the risks and costs experienced by system developers and vendors.

- Towards integrated systems and object orientation

Individual technologies and disciplines are being combined to address wider problems. For example, the drive towards a new generation of information servers relies extensively on the progressive fusion of work in advanced architectures, intelligent interfaces and deductive knowledge-based systems. Object orientation lends itself to conceptual modelling and software design methods. Similarly, object-oriented options are increasingly favoured in the development of new generations of information management systems.

- Excellent progress in technology transfer

The Parallel computing action (PCA) has enabled 55 academic and research establishments to acquire parallel systems, and over 300 researchers a year are now being trained in parallel computing techniques.

### Advanced Systems Architectures

Since its inception, this area of IPS has been pursued with the view that future computing needs cannot be adequately met by implementing conventional processing systems using ever-more exotic technology to increase basic clockrates and processing power. Work on highly parallel systems is now achieving dramatic reductions in cost/performance ratios, and the potential redundancy offered by multiprocessor systems is leading to ever higher levels of overall system dependability. The new generation of parallel processing systems are now offering supercomputer levels of performance at mini-computer costs, and, importantly, they are scalable, with low levels of incremental cost.

To date, IPS projects in this area have resulted in the construction of several prototype systems. An increasingly used standard component, the T800 transputer, has been developed and is now employed as the basis for a variety of commercial products. The T800 transputer, developed within SUPERNODE (project 1085), is the key component in a range of parallel systems offered by a group of rapidly growing SMEs that includes Telmat (F), Parsytec (D), and Meiko and Parsys (UK). By 1990, 240,000 T800 transputer chips had been sold, bringing sales to 400,000 units, the highest achieved for any RISC microprocessor. By 1995, the overall transputer market is expected to reach ECU1 billion. Further improvement of the basic architecture for large-scale parallel systems and their fundamental components is now being addressed by PUMA (project 2701) and GP-MIMD (project 5404).



### High-Performance Components Show Dramatic Improvements

In April 1991, following the successful development of the T800 transputer in the SUPERNODE project, Inmos (UK) announced its successor, the T9000. This is one of the world's most powerful RISC processors, with a peak performance of 200 Mips or 25 Mflops, and with four 20 Mbyte/s communications channels per chip. The T9000 is aimed at low-cost architectures and works with a 5 MHz clock (compared with 33 MHz for current scalar products). Today's transputer-based products range from 25 to 600 Mflops, providing supercomputing power at one-fifth of the cost. Through continuing development, the processing capabilities of the transputer have increased more than tenfold in three years.

Complementing the processing performance of the T9000 is a new communication chip, the C104, developed in PUMA (project 2701). A joint patent has been applied for by two of the partners, Inmos (UK) and Siemens (D). The improved communication mechanism is critical to improving the ability to scale up transputer-based parallel-processing systems, raising the number of nodes from, say, 1,000 to 10,000 in a single system. A combination of an order of magnitude improvement in basic node performance together with a further order of magnitude improvement in the number of nodes that can be deployed now offers a potential 100-fold boost to current Supernode-type systems.

SUPERNODE: the Mousetrap is a prototype handheld computer, made rugged for field use, based on a miniaturized Supernode processor module delivering 200 Mips. Developed by DRA (formerly RSRE), the Mousetrap system incorporates a 5" colour liquid-crystal display. An application being explored is the siting of transmitters in accordance with both technical (line-of-sight) and environmental considerations.

PADMAVATI (project 967) explored the architecture and environment appropriate for real-time artificial intelligence (AI) applications, for example in speech and image understanding. Such applications often require a dynamic routing capability in communication and an associative capability in data access. To meet these specific needs, a dynamic routing chip (DYNET) produced by Thomson-CSF (F) and a state-of-the-art CAM (content-addressable memory) from GEC (UK) are now commercially available. These results represent a major step forward in the development of architectures suitable for AI applications where real-time requirements must be met.

### Architectures: Further Exploration and the Need for Standards

GP-MIMD (project 5404) brings together a substantial group of European organizations concerned with the development and exploitation of transputer-based systems. In addition to work designed to point the way forward to a new generation of message-passing computers, there is a strong emphasis on the development of

a standard machine architecture and standard applications support interfaces. Operating systems providers Chorus Systemes (F) and Perihelion (UK) are collaborating to provide an improved operating system environment that builds on their current products (the Chorus micro-kernel and the Helios tools and environment, providing X-Windows and Unix capabilities).

Communications are important for parallel processors and have received significant attention within IPS, with new computational models and architectures being developed. The parallel random access machine (PRAM) model is a topic of research in PUMA (project 2701) and GP-MIMD (project 5404). GENESIS (project 1041) examines the issues to be addressed for ultra-fast distributed-memory architectures, and the current phase of the project concentrates on the challenging software issues. AMUS (project 2716) is exploring the development of ultra-fast, multi-processor, scalar-processing nodes.

The growth of distributed processor architectures offers both a challenge and an opportunity with respect to systems reliability and dependability. Both of these related issues have been addressed by DELTA-4 (project 818), where the main industrial partners Bull (F), Ferranti (UK) and SEMA (F) have an open-architecture, fault-tolerant demonstration distributed banking system for Credit agricole and a further manufacturing demonstrator with Renault.

### Software: Making Systems More Accessible

The 1990 Call strengthened the software component in the domain of high-performance architectures with the addition of COMPARE (project 5399), which is examining basic compilation technology and aims to extend, where appropriate, the technology in tools for compiler generation for parallel machines. It joins SUPERNODE II (project 2528) as the second major software project (software issues will be the main focus for future actions in the area). Telmat's T-Node supercomputer, derived from SUPERNODE (projects 1085 and 2528), takes just one second to analyse and display electrical signals from the brain monitored by electroencephalography. The key to unlocking the processing power of parallel computers is to provide software tools that make program-writing easier. SUPERNODE II has already ported a version of the Portable Common Tool Environment (PCTE) onto a Supernode system together with the world-leading standard numerical libraries from Numerical Algorithms Group (UK) and state-of-the-art simulation algorithms.

### New Approaches: Neurocomputing and Optical Processing

To complement the tools and methods developed in knowledge engineering, which are largely based on logical representation and deduction models, new kinds of information processing, generally referred to as neural computing, have been the subject of intensive R&D activities and growing industrial interest. The neural computing approach, inherently parallel and capable of dealing with incomplete information, is expected to lead

to more powerful and flexible information processing systems through the fuller exploitation of the possibilities offered by massively parallel architectures.

The approach taken in ESPRIT has been to evaluate the new technology of neural networks over a range of industrial applications, development tools and environments. These activities have been mainly carried out in ANNIE (project 2092), whose results are being delivered through a set of awareness and technology transfer actions. Another area of work aims to provide application developers with a complete software and hardware environment. PYGMALION (project 2059) delivered the MIMENICE software environment now commercially available from the Thomson-CSF (F) spin-off company Mimetics. The hardware environment is now under development in GALATEA (project 5293), where a silicon compiler for neural network ASICs is being produced.

Optical computing has the potential to play an important role in future information processing systems. The development of basic optical interconnection technologies is taking place in the Microelectronics area of ESPRIT, while the more speculative area of 'computing using light' has been investigated in COOP (project 1035) and is currently under examination in NAOPIA (project 2288). In conjunction with research on the basic technologies required to provide the appropriate range of components, the task of placing prototypes in industrial environments is under way. A hybrid acousto-optical image-processing system for parts recognition has shown promising results in COUSTO (project 866), and has been further improved in NAOPIA (project 2288) to a point far beyond the current video processing rate of 50 images/s—NAOPIA has demonstrated 1,000 images/s, adequate for HDTV-quality applications.

#### Information Servers

Work on information servers is aimed at overcoming the constraints placed on users by the current speed of access to computer-based information and the data manipulation and presentation facilities presently available. R&D activities in this area address the representation, distribution, availability and integrity of large volumes of complex, diverse information. The challenge is to achieve this in a way appropriate to the task at hand and the user's level of expertise. The projects concerned draw extensively on previous work on advanced architectures and knowledge engineering.

Current information management systems have difficulty in meeting the growing requirement for handling mixed-media information comprising images, graphics, speech and text. Dealing with an ever-growing volume and complexity of data is another challenge, equalled by pressure from users for more convivial ways of interacting with systems. Overall, it is estimated that traditional database systems are at present able to cope with only 5 percent of the total information available to the

average organization. A new generation of information management technologies is needed.

These considerations have been the driving force behind this new focus of interest. It draws on work undertaken in the advanced architectures sub-area, where highly parallel systems offer a clear potential for meeting the system performance figures required and where object management issues have been extensively explored. It also incorporates activities initiated in the knowledge engineering sub-area, where knowledge-based approaches have been used to improve the quality of human/computer interaction and have addressed the question of increasing 'intelligence' within the information store itself.

#### Higher Performance—The Continuing Challenge

Good progress towards a parallel engine front-ending a database with deductive capabilities has been made by the major project in this field, EDS (project 2025). The EDS delta network, optimized for high-performance parallel processing, is based on a 400,000 transistor ASIC designed by Siemens. EDS is evaluating the capabilities of the system in a selected range of commercial applications. The project has already established leading-edge results both in parallel computing, with the development of a distributed shared-store system, and in the relational database domain, with extensions to SQL. The three main commercial partners, ICL (UK), Bull (F) and Siemens (D), intend to exploit the EDS results in their future product lines.

In a complementary line of research, significant improvements in memory management have been achieved by STRETCH (project 2443). This project is concerned with systems supporting the representation and manipulation of large knowledge-bases, and the project team, coordinated by Alcatel Alsthom Recherche (F), has developed a very fast main-memory object manager and is progressing towards a full-scale demonstrator.

#### Making Information More Available: Database Distribution and Integration

Integration of new systems with existing databases is a key factor in encouraging IT uptake, and progress has been made towards solving one aspect of this problem in EPSILON (project 530). The project has successfully developed an environment which facilitates the building of a distributed knowledge-based management system layer on top of existing database management systems. The system is being used for a banking application and as part of a treasury management support system, and its implementation on parallel architectures is being further explored in the EDS project.

Heterogeneity in database systems is another factor which has to be addressed, and this is being tackled by KIWIS (project 2424) and AIMS (project 5210). KIWIS has implemented a 'federation' of KIWIS nodes and is

investigating interfaces to SQL. AIMS places considerable emphasis on extending traditional database functionalities in addition to incorporating knowledge components as well as methods of reusing existing information sources. Both KIWIS and AIMS draw on results from previous ESPRIT projects.

#### **Making Information More Accessible: Improving the Utility and Knowledge Components**

All of the above projects address, in a variety of complementary ways, the addition of 'intelligence' to the information stored within the system and advances in the manner of the interaction with the user. Further recent additions to the IPS portfolio in this general domain are PLUS (project 5254) and EMIR (project 5312), examining the use of linguistics to support information retrieval.

#### **Systems Design and Engineering**

Software and related services is already the second largest component of the IT industry and are forecast to become the dominant source of business in the course of the decade. Europe accounted for 23 percent of the ECU63 billion world market for software and services in 1984, and this share is estimated to grow to 33 percent of an ECU353 billion world market by 1993. Furthermore, this leading position does not take into account the activities in software development undertaken in user organizations, estimated to be an order of magnitude larger than that accounted for by the traded software sector.

Software is now clearly positioned as the major added-value component in most IT systems. Moreover, given the critical contribution of these systems to the efficiency and responsiveness of the organizations in which they are deployed, a capability to design and realize such systems in a cost-effective, predictable manner and to appropriate quality standards is vital to the future success of both the European vendor and user industries.

IPS activities in systems design and engineering have contributed substantially to methods, tools and standards that are laying a basis for a strong European capability in this domain. Work to date has demonstrated the increasing convergence of traditional software design and engineering with the newer field of knowledge-based systems engineering.

Work on systems design has focused on developing improved methods for the design of software applications, providing new tools to support these methods and establishing a standard framework within which the tools can be deployed to support project teams.

#### **Systems Design Standards**

The IPS-led work on a Portable Common Tool Environment (PCTE) has led to the definition of a standard which was recently (December 1990) confirmed by the European Computer Manufacturers Association

(ECMA) as ECMA Standard 149. The work leading to the standard and originated in a cluster of ESPRIT projects centred around the original PCTE research (project 32), and was subsequently pursued, with ESPRIT's support, through the standardization procedures of ECMA and the technical committee responsible for its definition.

The standardization work attracted wide international support and encouragement, not only from the major European vendors but also from major US players and Japanese companies. Important technical input has also been provided by the independent European Programme Group, a nine-nation consortium within NATO, which has mounted a programme to validate the PCTE standard in terms of its suitability for defence needs. The Group will use the results of the validation activity to help with the further evolution of the standard.

An additional important contribution of this work has been a reference model for CASE (computer-aided software engineering) tools, which was also adopted by ECMA. The quality of this work has been confirmed by requests from the US National Institute of Standards and Technology to collaborate on the development of the ECMA model as the basis for their own work on reference models in this area.

The emergence of a standard and the progressive agreements on a CASE reference model are important steps in improving the market for CASE tools and environments. They provide the user with wider freedom to mix and match individual tools to suit particular requirements, and offer vendors the possibility of lower development costs as they can increasingly work to accepted interface standards. PCTE environments are now commercially available on workstations from Bull, DEC, HP, IBM and Sun. Software environments and PCTE-compliant tools are now being offered by a range of software suppliers such as SFGL, Syseca, GIE Emeraude and IPSYS.

#### **Systems Design: Key Contributions to Software Assessment**

Given the significant role that software now plays, the development of objective methods of assessment is increasingly seen as an important further step in developing the market for software products. Well-founded assessment processes are seen as contributing to a more open and better relationship between customer and supplier.

After only two years of work, SCOPE (project 2151) has already delivered a number of key recommendations to European standards bodies on this important issue. The tools and process being developed within SCOPE are continuing to be applied to a wide range of case studies to give further authority and confidence to the recommendations made and to extend the range of assessment approaches and the number of products that can be assessed.



Reliability issues and safety-critical systems are topics of special importance in the field of software assessment, and these have been addressed by REQUEST (project 300) and MUSE (project 1257), respectively.

REQUEST has provided improved and validated techniques for measuring and modeling software quality and reliability, and has exchanged tools with the Alvey software library, with further agreements under negotiation. REQUEST metrics are in use in ICL (UK) to define software quality environments, in Elektronik Centralen (DK) who provide services to other Danish companies, and in other ESPRIT projects.

MUSE has progressed the state of the art in the assessment of safety-critical systems. Partners are now providing expert services, incorporating results into their own internal procedures, organizing technology transfer to wider groups, and have produced technology prototypes aimed at supporting the assessment of important classes of system. SAMSON, a prototype expert system developed by the project to help assess the quality of safety-critical systems, has already been requested for use by companies outside the consortium. ATHENA, a tool for complexity measurements and maintenance assistance, and DEMETER and MODECON, for calculating design metrics based on two simple description languages, are other important outputs from the project.

Transferring results into the marketplace has been a focus of attention in IPS, and an early achievement in this field has come from METKIT (project 2384), which has already provided enhanced tools for teaching software metrics to managers, software engineers and students. The main features include a modular course structure, computer-aided-learning (CAL) techniques, and the use of video. Future developments of the work may include the use of CD-I.

#### **Systems Design: Contributions to Products**

In addition to the extensive range of products stemming from the PCTE actions noted above, the work on system design, especially on object orientation and software reuse, has contributed to further product offerings which are now coming on to the market. ESI (F) have used results from KNOSOS (project 974) to further consolidate their world market lead in crash simulation software. The KNOSOS techniques for software reuse are now incorporated in CRASHSTATION, a support tool for the PAM-CRASH system, used by the great majority of car manufacturers world-wide.

GSI Tecsì (F) and TXT (I) are both exploiting results from DRAGON (project 1550). GSI Tecsì is marketing the job supervisor that was explored within the project and which supports the execution of multiple Ada programmes on target systems. The improved experience with multiprocessors has served as the basis for a new real-time craft multiprocessor product. TXT is pursuing the industrial exploitation of the object-oriented language and the preprocessor developed in the project. A number of companies and consortia have indicated

interest in acting as beta test-sites, and evaluation copies of the preprocessor are currently in use both in Europe and the USA.

#### **Knowledge Engineering**

Knowledge engineering has been of increasing importance in the field of advanced information processing systems and is making significant contributions to systems design and engineering.

#### **Knowledge-Based Systems: Developing the Market**

A significant set of projects were established in the earlier phase of the programme to demonstrate the practical application of knowledge-based systems (KBS) to problems on a scale found in real-world applications. The aim was to demonstrate that the technology was mature enough to begin to offer solutions to a broad class of systems problems. Successful applications of the technology have now been demonstrated in areas as diverse as process control, manufacturing, diagnosis, banking, intelligent interfaces, and medicine. Using the technology is now almost routine in many computer-integrated manufacturing (CIM) and advanced business and home systems—Peripherals (ABHS-P) ESPRIT projects. Knowledge-based systems have gained widespread acceptance.

Application demonstrators within the Knowledge engineering area of IPS have made a major contribution to the development of this market, leading to products such as SPIRITS from Syseca (F), and ESB 96, an expert system shell developed by Plessey (UK) and sold by Siemens (D). These products support the development of intelligent interfaces and are derived from earlier work done in ESB (project 96). CARMEN, a user interface builder and rapid prototyping tool sold by BIM (B), is a result of LOKI (project 107). An expert system shell based on EMG (project 599) is commercially available from the start-up company Hugin, and SPIRAL, a Prolog program environment for safety-critical application areas based on work in ALPES (project 973), is available from CRIL (F).

#### **The Need for an Engineering Approach**

With the rapid acceptance of knowledge-based systems (KBS) technology as a significant source of adding value to more traditional software systems, the development of methods and tools to support the building of well-founded knowledge-based systems has become an R&D priority. Several IPS projects have made important contributions to this end.

A methodology for the critical knowledge acquisition phase of knowledge engineering has been provided by KADS (project 1098). This methodology, now marketed by the commercial partners, has attracted the attention of other companies such as Arthur Andersen and IBM, both of which are adopting KADS as a standard methodology. Academic partners have established broad-based technology transfer actions and supporting tools,



including the object-oriented graphical language, PCE, developed by Universiteit van Amsterdam (NL), and the Shelley workbench. These are now on the market both in Europe and the USA. The KADS results have also been used by two projects led by CAP Gemini (F). ACKNOWLEDGE (project 2576) is aimed at the construction of a knowledge engineering workbench to provide an integrated environment for knowledge elicitation and acquisition, and KADS II (project 5248) aims to extend methods to support the full life-cycle of KBS projects and will examine the issues of integration with software engineering tools and techniques.

### Engineering Specific Applications

Work has also been directed at the engineering of more specific KBS systems, such as those that are distributed or have to meet real-time constraints.

KBS-SHIP (project 1074) is concerned with engineering distributed, cooperating systems. Coordinated by the Danish Maritime Institute, it aims to help bridge and engine-room officers carry out duties ranging from voyage planning to alarm-handling by providing a decision-support system and a standard framework for integrating shipboard data communication and information systems.

The novel KBS-SHIP approach is to combine artificial intelligence techniques with operational analysis methods to help with drawing up plans for voyages, alarm diagnosis and handling, and in preparing maintenance schedules and loading plans. A computer-based systems manager supervises the communication and collaboration of the individual systems, drawing on the support of individual expert systems, which include one storing all the relevant regulations governing the operation of a complex ship. Other subsystems include the expert voyage pilot (EVP) and expert loading system (ELS). The voyage planner has been demonstrated, is currently on sea trials, and is being commercialized by Krupp (D). An expert system product for machinery operation, stemming from the same project, will be available from Soren (DK).

Real-time issues are being addressed in AITRAS (project 2167), which is building a system shell and design tools for the real-time analysis of instrumentation signals. Prototype system components have been completed and are being tested on a number of safety-critical applications, including the non-destructive diagnosis of faults in nuclear steam generator turbines. Project partners Laborec (B) and Tecnom (E) have exploitation plans for both the industrial applications and the tools and techniques with which the applications can be built, while partners Cognitec (F) and AI Systems (B) are using the techniques in other products.

### Developments in Constraint Logic Programming (CLP)

In addition to the advanced engineering concerns discussed above, other R&D in IPS ensures continued support for the further development of technology in

areas of broad potential and wide application. Constraint satisfaction is one example, where the close integration between numeric and symbolic processing has already provided manageable solutions to problems that have hitherto presented major combinatorial difficulties. Application domains as diverse as production planning, VLSI design, diagnosis, financial systems, logistics and network management have all been shown as areas where the application of CLP has the potential to offer significant benefits.

ESPRIT has contributed substantially to establishing Europe as a source of leading-edge competence in the CLP domain. The Prolog III product from Prologia, derived from the work on PROLOG III (project 1106), incorporates strong constraint resolution capabilities. It is currently the most widely-used CLP tool available world-wide, with more than 300 licences already sold. Furthermore, the user partners in the project, Daimler-Benz (D) and Robert Bosch (D), now plan to continue to exploit CLP techniques internally for diagnosis and testing and for CAD. The application domains are being further developed in CHIC (project 5291) and the supporting technology in PRINCE (project 5246).

### Further Moves Towards Systems Engineering

A significant step towards defining a common systems engineering model suitable for a wide range of applications has been made with the completion of the definition stage of ATMOSPHERE (project 2565). This major project extends the concepts and approaches developed within software engineering to embrace the full set of systems engineering requirements. It aims to integrate key aspects of CAD, CAE and CASE support, using existing technologies (such as PCTE) where appropriate, and to establish an architectural framework and supporting integration technologies to ensure that the ATMOSPHERE tools and environments are open and well integrated. The project brings together many of Europe's leading CASE and system engineering players. 'Proof of concept' demonstrators have already been developed, and the major partners aim to build well-engineered environment demonstrators addressing four important application areas:

- aerospace systems and distributed systems, using a framework integration approach;
- digital computer network systems, again with a framework integration approach;
- communications systems, with a toolset-driven integration approach;
- process control systems, with a combination of toolset- and framework-driven integration.

The environments will all be piloted and evaluated through the involvement of systems engineers in selected partners' products divisions. Environments and toolsets resulting from the project are planned for subsequent commercialization by partners, as is a substantial programme of technology transfer.

The progressive intersection of system design with knowledge-based systems engineering has reached a point where it is beneficial to treat further developments as a joint set of actions. The focus in future will be on systems engineering techniques.

#### **Signal Processing Systems**

This sub-area of IPS R&D exemplifies, above all, the need for a true systems engineering approach. Signal processing projects draw extensively on the technologies of knowledge engineering and advanced architectures, build complex software and hardware components, and engineer their overall integration into major IT systems.

The work is concerned with systems where large quantities of complex, external-world data have to be recorded and handled in real-time, and focuses on the provision of 'automatic' interfaces that enable a computer system to respond promptly to external stimuli. Such systems are the critical components of applications involving speech recognition and vision applications, and they are finding their place not only in industrial applications, such as robotics and inspection, but also in medical imaging, environment monitoring, and systems to aid the handicapped.

Two major application areas are covered in IPS signal-processing work: vision and speech understanding.

#### **Vision Systems: 'Open Architecture' Standards**

Computer vision systems are increasingly becoming the high-value component in systems that address applications such as surface inspection, parts recognition, quality control, testing and measurement, and tracking. As the more rapid deployment of such systems is greatly impeded by comparatively high system and development costs, it makes economic sense to aim for the establishment of more cost-efficient standard interfaces and components. ARVISA (project 5225), launched as a result of the last call, brings together major European vision systems organizations committed to achieving practical standards for the interfaces, protocols and software components that will comprise the vision systems likely to be on the market over the latter part of the decade. ARVISA is seen as a project of strategic importance.

#### **Scene Understanding: Technical Challenge and Major Market Opportunity**

A current major weakness in systems designed to understand scenes is the comparative lack of machine-readable knowledge concerning the information needed to process images. MUSIP (project 2316) has built a prototype image database combined with a knowledge-based scene-understanding workstation and powerful data-handling facilities. The prototype is currently being validated on a medical imaging system and a remote sensing application concerned with flood and deforestation monitoring.

In this same area, SKIDS (project 1560) has demonstrated a system that can merge numeric and symbolic

data and is able to reason about the scene under observation. SKIDS has developed the principles of a generic architecture for multisensor integration, with particular emphasis on two classes of application: mobile robots, where the sensors are grouped together but the environment is unknown, and wide-area surveillance systems, where the sensors are distributed but fixed. The latter can be used for monitoring offshore oil-fields, nuclear plants and airports.

The results of the work are now being integrated into a surveillance system in VIEWS (project 2152), which will extend the 'understanding' capability to encompass moving scenes, with applications at airports and in motorway traffic control.

#### **Speech: Excellent Progress in Setting Quality Assessment Standards**

Many of the key European speech organizations have come together in SAM (project 2589) to define standards for the assessment of speech synthesis and recognition systems. Until recently, access to a systematically recorded set of data has been highly restricted, and this has inhibited the development of quality speech system components. In 1991 SAM established the first multilingual database, consisting of a set of 16 CD-ROMs containing speech recordings in eight European languages, along with recognizer tests and scoring protocols. This database now represents a major European asset. Standardized hardware definitions and software support packages have been developed, providing uniform facilities for database acquisition, annotation and management. The SAM standards are already in use in Europe and North America, and the SESAM workstation has been accepted as a reference.

#### **Future Speech Products**

The provision of a common testbed for speech technology applications is a key component in the progress towards the achievement of an increased volume of speech applications. This is one of the aims of SUNSTAR (project 2094), which has developed an operational dialogue design tool. SUNSTAR focuses on the development of human/computer interfaces based on speech input and output, and is aimed at the professional office and public telephone network environments. The project concentrates on the integration of existing technologies, with the tools currently in use for developing three major application demonstrators combining both speech understanding and synthesis. SUNDIAL (project 2218) is also concerned with methods of using speech in the human/computer interface, and is developing the technologies of continuous speech recognition and understanding. The application prototypes planned are interactive information services, including a hotel vacancy database (Italian), and a flight enquiry and reservation system (English and French).

A multilingual dimension is contributed by POLY-GLOT (project 2104) through the provision of a text-to-speech/speech-to-text system for six European languages. An automatic language identifier for five of these languages has already been demonstrated, and two medical dictation systems developed, for radiology (in Italian) and pathology (English).

#### Awareness Activities

##### Parallel Computing Action (PCA)

IPS has made a considerable investment in technology transfer in the parallel computing area. Following a competitive call for proposals, the Parallel Computing Action (PCA) has now established systems in 55 academic and research establishments throughout the Community. An additional 20 institutions are invited to participate in twice-yearly information workshops. The Inmos (UK) T800 transputer is the basis of most of the research vehicles in the selected projects. As a result, some 300 researchers per year are now given exposure to, and training on, parallel systems. This is a considerable contribution to widening the European skill-base necessary to push forward development in this area.

##### ESSI: European Systems and Software Initiative

Considerable attention has also been devoted to the planning of a major European systems and software initiative (ESSI) that aims to secure a sharp increase in the productivity and capabilities of system and software engineers by encouraging the take-up and use of modern system design and production techniques. SMEs will receive particular attention.

The background to ESSI lies in the continuing trend for European companies to become more and more dependent on information technology to achieve and maintain internal efficiency, quality of service and competitive edge. Information technology systems are extremely software-intensive, yet the complex software needed is difficult to specify and design, costly and time-consuming to develop, and are not easily tested before use nor subsequently maintained. Moreover, most system designers and programmers employ tools and methods developed some time ago, though more recently developed techniques can provide significant gains in productivity and quality. These factors have led to an acute crisis of supply, which ESSI will address in three main ways:

- *Application experiments*, by supporting the critical testing and evaluation of advanced methods and tools. The intention is to reach system and software project leaders, opinion-formers in a position to introduce and foster the use of new techniques.
- *Training*, with activities aimed at establishing the better understanding and acceptance of the best methods and tools available, underpinning this with provision for the upgrading of existing skills.
- *Dissemination*, with Community-wide awareness and

dissemination activities to link communities of developers and assist the rapid transfer of new and proven tools, methods and services into the marketplace.

A pilot phase will be launched as part of the new phase of ESPRIT, beginning later in 1991 with the selection by open competitive tender of an ESSI service organization responsible under contract to the Commission for the day-to-day administration of the initiative.

##### Special Interest Groups (SIGs)

IPS has encouraged the formation of a number of Special Interest Groups (SIGs) among partners of IPS projects. Current SIGs are active in:

- LISP,
- Vienna development method (VDM) and formal methods,
- Metrics,
- European Languages Standards Group for MIMD computers,
- Software maintenance.

#### Nuclear R&D

##### German Intelligence Chief Reviews Third World Nuclear Potential

92MI0160 Bonn DIE WELT in German 2 Dec 91 p 7

[Interview with Federal Intelligence Service Chairman Konrad Porzner by DIE WELT: "Iran Will Be Capable of Building Atomic Weapons by the Year 2000"; first paragraph is DIE WELT introduction]

[Excerpts] He is the first social democrat to head the Federal Intelligence Service (BND): Konrad Porzner, 56, former Berlin senator for finance and until 1990 member of the SPD [Social Democratic Party] caucus in the Bundestag. In a report to the federal government he sounded the alarm that in addition to Iraq, also Syria, Libya, and Iran are making atomic, chemical, and biological weapons with German assistance. What discoveries led Porzner to say that? How does he view the political situation in the Soviet Union? What has come of the public offer from the KGB to cooperate with the BND? Is there a need for a worldwide investigation and intervention team run by intelligence services? Konrad Porzner was interviewed by Manfred Schell and Werner Kalinka. [passage omitted]

**DIE WELT:** In a report to the federal government you sounded the alarm, saying that apart from Iraq, Iran, Syria, and Libya are building atomic, biological and chemical weapons using technology obtained from Germany. What detailed knowledge caused you to give this warning in Bonn?

**Porzner:** The BND is constantly reporting on armament in the third world. It is not watching particular countries.

I wasn't sounding an alarm. We compiled a comprehensive report from the large number of findings about armament with ABC [atomic, biological and chemical] weapons and missiles in the Near and Middle East that we had passed to the competent authorities. This report reveals the full extent of the threat. The federal government is extremely interested in these BND reports. It follows up every detail.

But I think it is important to stress that it is not only a German problem. It is a problem involving many industrialized nations and many developing countries. It is after all a complex interrelationship between firms and technological mercenaries in the industrialized nations and in many developing countries. Countries no longer commission a general contractor and say: Right, build me that. Orders for a plant are spread among dozens of firms in many countries and products are delivered by roundabout routes. It is difficult to uncover it.

The crucial question is: What are a particular country's intentions as regards its arms policy? We focus on analyzing this to find out what it is buying. So we can only expect success if we look abroad, where the procurement activities originate and where the articles converge from various directions.

We should be doomed to failure from the start if we were to try to supervise German exports totaling 640 billion German marks made up of millions of separate transactions. To do that you would have to abolish our economic order. Only a totalitarian state can do it.

**DIE WELT:** What do you conclude from all this detailed knowledge and information?

**Porzner:** That if things continue as they are, a number of states will have A, B, and C weapons and the missiles to deliver them in less than 10 years. Third World countries are also cooperating closely with one another to improve missile technology. North Korea is very active here. States are reaching a position where their industrial policy will make them autonomous, independent of supplies from abroad.

**DIE WELT:** What is the precise position regarding North Korea and Scud missiles?

**Porzner:** North Korea is not only supplying Scud missiles, it is also helping other states to build production plants for Scud missiles and to extend the Scud's range.

**DIE WELT:** But that is turning the military situation in the Middle East on its head.

**Porzner:** Yes, there is that danger.

**DIE WELT:** What role is Iraq playing in this? As far as nuclear technology development is concerned, it had been hoped that crucial plant had been destroyed or at least crippled for years to come. But now we are hearing a different story from the International Atomic Energy Authority. How do you see the position?

**Porzner:** The war and its consequences were a setback for Iraq, but it is still dangerous. Iraq is probably becoming a source of know-how for ABC weapons and missiles. If Iraq is not subjected to intensive controls, it will have regained its earlier technology level in about two years.

**DIE WELT:** What role does Iran play in this scenario?

**Porzner:** A big one. But I don't want to play down the significance of Iraq, Pakistan, and China because of it.

**DIE WELT:** Are there any signs that Iran is keeping its options open about embarking on an atomic weapons program to manufacture a plutonium or uranium bomb?

**Porzner:** They already had a nuclear program under the shah, and it has been further developed. Iran is keeping its options open about embarking on an atomic weapons program for a uranium and plutonium bomb. Although there is at present no evidence of production, Iran will be capable of building atomic weapons by the year 2000 if it continues its armaments activities at the present level.

**DIE WELT:** Has Iran gotten hold of the plans of Rabta? What would be the consequences if it had?

**Porzner:** There are increasing quantities of plans and blueprints for weapons factories "on the market." Iran has probably gotten hold of the building plans for the factory in Rabta and is evidently in the process of buying the necessary parts. But we have no evidence of German firms supplying them or being involved.

**DIE WELT:** There have been reports that the Rafsanjani family is directly involved.

**Porzner:** I can't say anything about that because individuals are not the problem. The crucial matter is whether a state wants to carry through such an armaments program.

**DIE WELT:** Is there any information about Syria in this regard?

**Porzner:** Syria is improving its missile capabilities. Scud missile production is being built up there with North Korean assistance. Syria is also engaged in ABC weapon research and development; it has warfare agent factories.

**DIE WELT:** Hasn't the resolution of the east-west conflict basically made the international situation much more fragile overall?

**Porzner:** It must first of all be said that we are very pleased that the east-west conflict is over. It means that the greatest direct threat to Europe is a thing of the past.

But unfortunately the world has not become any more peaceful. The states that are arming themselves with the most modern military technology are taking advantage of new opportunities. The abolition of the Warsaw Pact, the weapons available there, and the many specialists highly qualified in the field are new, dangerous factors. As the arms industry in these countries is run down, specialists lose their jobs. They are now faced with the



temptation of working for rich countries, for salaries of \$10,000 a month or more, rather than sinking into poverty at home. It is a tremendously explosive political issue.

Basically, now that the world has managed to put an end to the east-west conflict and to agree on disarmament, it must now use worldwide treaty arrangements to prevent the Third World from arming.

**DIE WELT:** Of course, another crucial factor is the sense of responsibility that the owners of these weapons have. Can we expect that in those parts of the world?

**Porzner:** I can only hope that those who possess such weapons have sufficient sense of responsibility towards both the world at large and their own people not to use them. The worldwide debate on disarmament must have made clear to everyone that anyone who uses atomic weapons faces annihilation himself.

**DIE WELT:** Pursuing the basic information you have given us to its logical conclusion, does this mean that the world will soon have to decide once again to put someone in the Middle East in his place?

**Porzner:** East and West have managed to agree on disarmament by treaty. We must not give up hope of succeeding in doing so in today's troublespots as well. The east-west conflict did not end in disarmament as a result of the use of force, but through treaties, and ultimately through common sense. In the end it will not be achieved any other way in the Middle East.

**DIE WELT:** What about those German firms: Are they lacking in awareness? Is business still taking priority over morals?

**Porzner:** That is difficult to say overall. Firms often do not know for what purpose they are supplying goods or working. The true purpose of a delivery can only be determined from its final destination. Basically, the problem can only be solved if everyone with production capacities of this type feel morally obliged to turn down such business. To this extent it is also an ethical problem. In any case, I would like to stress once again that it is not the BND's task to monitor German firms.

**DIE WELT:** Do we not need an intelligence gathering and intervention force on a world scale?

**Porzner:** It would be utopian to imagine that the UN could create such an instrument. For the time being we must work in cooperation with our counterparts in other countries, as indeed we are doing. [passage omitted]

#### **French Institute Develops Atom-Level Microprobe**

92BR0166 Paris SCIENCES & AVENIR in French  
Jan 92 p 9

[Text] From now on, manufacturers are going to be able to control their samples very closely; the first operational atomic microprobe is now available in France. It will

make it possible to locate atomic defects in electronic components, to measure the impact of aggressive environments on metal surfaces, or, for cosmetic products, to evaluate the distribution of calcium, for example, on the cross-section of a hair.

Developed by the Center for Nuclear Studies at Bordeaux-Gradignan, the microprobe directs a particle accelerator-produced high-energy ion beam (2 million electronvolts) at the sample. The particle beam first passes through a platinum-iridium alloy diaphragm 0.01 millimeter in diameter, before being focused by four electromagnetic lenses, which reduce its size by a factor of 10. The size of the beam is thereby reduced sufficiently to gather information about the elementary make-up of the sample. The microanalysis consists in studying the results issuing from the interaction between the particles and the sample. Various analytical techniques can thus be implemented, such as measuring the backscattered ions striking the atoms of the target.

#### **UK To Halt JET Operations Until 1993**

92WS0212C Paris LE MONDE in French  
4 Dec 91 p 18

[Article by Jean-Francois Augereau: "Reinventing the Stars"; first paragraph is LE MONDE introduction]

[Text] Despite the Europeans' recent success, the race toward thermonuclear fusion will demand still more effort, time, and money.

The advance achieved by European physicists when, around the beginning of November, they succeeded in producing "a significant quantity of energy" by thermonuclear fusion (LE MONDE 12 November), has opened a door toward the harnessing of a practically unlimited source of energy. For two seconds, teams led by Paul-Henri Rebut, director of the Joint European Torus (JET) at Culham, in Great Britain, obtained approximately 1 megawatt of energy in their strange machine. A tiny amount compared to the 3,000 megawatts or so of thermonuclear energy being produced by the fission of uranium<sup>(1)</sup> in the nuclear reactors of the EDF [French Electric Power Company]. But an important result considering the numerous disappointments this form of energy has so often engendered.

The aim of the physicists is to recreate the energy of the stars in a bottle. A very special bottle, to be sure, whose shape, conceived almost 40 years ago by physicists of the Soviet Kourchatov Institute, resembles a metallic inner tube approximately 3 meters in diameter—the torus—containing the highest possible vacuum, and embedded in a jumble of electric cabling, conduits, and tubes of all sorts, from which the outlines of huge coils emerge here and there, that are capable of generating powerful magnetic fields.

It is hard to imagine easily harnessing an energy that manifests itself at temperatures of 200 million degrees, or 10 times higher than those reigning inside the sun! No

known material is capable of withstanding a furnace heat of that magnitude. Hence the development of these famous tori, better known by their Soviet name of "tokamak(s)," whose magnetic fields make it possible to contain, distant from the walls of the inner toroidal chamber thus formed, the gaseous mixture that will be introduced into the chamber, then heated to plasma temperature—a plasma of deuterium and tritium<sup>(2)</sup>.

### Passport to Ignition

When research began more than three decades ago, enthusiasm was such that many imagined the problems would be quickly resolved. But nature has imposed its law and has often sown the seed of doubt in the minds of the most confident researchers. Not just anyone can harness the sun. It has taken 30 years of patient research to attain the remarkable, yet very preliminary, result achieved by the JET team. Today, no one is failing to recognize the truth: It will be another 50 or 60 years before a fusion reactor on a commercial scale sees the light of day.

The tiny step attained in Great Britain is being assessed as follows: "A tiny step but a decisive one," says Robert Aymar, the AEC [Atomic Energy Commission] director of materials sciences. "It is true," he says, "that the JET experiment is symbolic. But it confirms the advances that have been made and, more importantly, augurs well for the prospects." True, the JET, the world's best fusion machine at this time, is still distant from that frontier that is termed the break-even point, the operating point at which the fusion reactor produces as much energy as it consumes. As of now, the JET consumes several tens of megawatts to heat the plasma, whose nuclear reactions produce no more than 1 megawatt... And for only two seconds.

Thus, it is easier to measure the advances still needing to be made in order to merely come within striking distance of the target. Clearly, it will be extremely difficult to attain, then to pass, the point defined by the Lawson criterion, the somewhat mythical law that combines, as if by magic, the temperature of the plasma, its density, and its duration. Lacking this minimal passport, no salute. Lacking it, the physicists will not attain the second stage—termed ignition—in the harnessing of thermonuclear fusion. The stage in which the fusion reaction within the machine becomes self-sustaining.

At this time, the JET is flirting with ignition. At peak performance, the product of plasma density (number of particles per cubic meter) multiplied by the temperature attained and by duration of the reaction came to around eight followed by 20 zeros. "Now," says one specialist, "we must attain at least a figure of five followed by 21 zeros." The meanings of such figures are beyond the ken of the uninitiated. But simply put, they mean that it will be several years yet before the physicists can hope to claim victory, and before "Lawson," in a manner of speaking, "will have thrown in the sponge." A step has been commenced at Culham. For there to be a more

decisive breakthrough to another stage, others will be necessary, some of which are not solely of a technical nature.

### The Cold Fusion War

The ball is therefore still in the physicists' court. Following the successful November experiment, in which, for the first time, a small amount (0.2 g) of tritium was injected into the machine, the Culham teams plan to shut down the JET around the beginning of 1992 for a period of 18 months. This shutdown is made necessary by the need to analyze the results of the experiment before a new experiment can be undertaken. But also by the fact that the use of tritium, a radioactive isotope of hydrogen, has made the interior of the installation slightly radioactive.

"We must avoid too high a level of residual radioactivity of the machine, so as to be able to test new setups with a greater margin of assurance before starting a new and more epochal experiment." Following this forced 18 month shutdown, a new period of approximately 18 months of operation will begin around mid-1993, without tritium, with deuterium alone. Only after the gradual introduction of increasing quantities of tritium will the final program begin that is to lead to the injection of equivalent quantities of tritium and deuterium into the torus.

At that point, if everything goes well, the Lawson frontier should not be distant. A milestone will have been attained in 1996 with the dismantlement of the JET, which, after 13 years of good and loyal service, will have enabled Europe, as in the case of particle physics, to play a leading role in the race toward fusion. Another lap in the race will undoubtedly begin with the initial tremors within the scientific community with sights set on starting up the next-generation machine.

Several countries are in the running, including the Americans, whose TFTR [Tokamak Fusion Test Reactor] at Princeton has just seen Culham steal a march on it; the Japanese, whose JT-60 is taking its toddling steps; and the Soviets, fathers of the technique, whose T-15 is having so many problems getting off the ground that many doubt that it will ever rival existing installations. In this context, each country is feathering its own nest, bent on playing the leading role when the time comes to play it.

Very early on, the Europeans gave some thought to what the next-generation machine should be like. They even gave it a name: The NET for Next European Torus. In 1990, they froze the objectives of this new installation,

and set 1996 as the date for a decision on the project. The cost of this operation: ECU3 billion, or around 21 billion francs[Fr].

In view of the size of the financing needed (3), thought was given to the idea of cooperation on a global scale. In 1987, President Gorbachev proposed to the other heads of state that the Americans, Europeans, Japanese and Soviets all agree to cooperate in building a joint ITER [International Thermonuclear Experimental Reactor]. In February 1988, the 12 member countries of the EEC grudgingly endorsed a cooperation based on this project, on condition, however, that it be headed by the International Atomic Energy Agency.

### Oceanic Riches

At the outset, it was all somewhat vague, distant in time, and of a nature to preserve the interests of each. But events moved fast. Unofficial agreements, not always technical ones, were entered into, and the Europeans suddenly found themselves somewhat on the outside of things. There can be no doubt that JET's most recent performance enables them now to negotiate from strength for moving from the studies that defined the general outlines of the ITER project to specifying the content of the machine. "We," say the Europeans, "do not want any part of an ambitious all-purpose machine. Progress has to be made step by step, and the objectives of ITER must be limited to those of the NET."

"Only in this way will we be able to work," say the Europeans, provided also that a solution is found to the political problems inherent in all international projects, and that the United States does not come out with one of those scenarios in which it holds the secret, and everyone is expected to work while it controls the entire undertaking. There will have to be meetings and more meetings beyond those in Washington, Vienna, Brussels, Tokyo, and those of 13 and 14 November 1991 in Moscow, to agree on and launch this new machine, which, if all goes well, is to be operational by 2005. "The only sure thing," says one specialist, "is that it will not be ITER and the NET, but ITER or the NET."

One thing is certain. Whatever the difficulties encountered, be they political or technical, the race to harness fusion will continue. The stakes are extremely high, for if, within half a century, controlled fusion of the atom becomes a reality, humanity will then have an almost unlimited source of energy. The fuel these reactors will burn exists in abundant quantities. Deuterium is present everywhere on Earth. Especially in the oceans, where this heavy hydrogen atom combines with oxygen to form... heavy water, of course.

Seawater contains one molecule of heavy water—that is, a molecule containing two atoms of deuterium—for every 6,000 molecules of light water. More simply stated, there are 40 milligrams of deuterium per liter of seawater. And since the oceans represent a volume of some

1.3 billion cubic kilometers, they are a practically unlimited reserve at our disposal, at a relatively very low cost of extraction.

Tritium, the second ingredient of the reaction, does not exist in nature. It too, however, is no problem. Suffice it to utilize the neutrons produced by the fusion reaction, which in contact with a coating of lithium (a chemical element that is also very abundant) produces the necessary quantities of tritium. It is all very simple on paper, and some may be ready to sell the idea that fusion is a tomorrow morning thing. But there is a great deal of road to be traveled before the combustion of a few kilograms of a mixture of deuterium and tritium, from lithium, can be made to produce as much energy as 10,000 tons of oil.

The tiny megawatt produced by the JET for two seconds seems very distant from the mark, and the physicists in the midst of the debate know very well that before thinking of installing plants to produce deuterium and tritium they will have to resolve the problems of overheating of the machine, problems of strength of materials, and problems of stability of the plasma, and be able to design and build an installation capable of attaining and sustaining the state of ignition for durations of 1,000 seconds.

It could be ITER, and in that case the difficulties will not stem from fuel supplies, since several sources will be available to supply the 20 kilograms or so of tritium necessary for a period of 10 years: The Canadian Candu type of nuclear plants, the installations in countries that have a military nuclear program, and military stockpiles, some of which will be dismantled.

Instead, the scientific community will have to progress and come to an understanding, enabling it, in a successive stage, to demonstrate the "feasibility" of a nuclear fusion reactor, and then to verify that the cost of an initial prototype will not exceed by more than three to five times that of a conventional nuclear reactor of the same power. "Today," says Robert Aymar, "there is nothing on the horizon that could possibly prevent us from arriving."

But he warns that "while it is undeniable that this form of energy will be more abundant, cleaner, and safer (a Chernobyl is impossible, since the reaction extinguishes itself when the plasma cools), it will nevertheless produce, like its distant sister, fission, waste equivalent to that produced by fission reactors."

### Footnotes

1. In a fission reaction the heavy nuclei of the uranium and plutonium atoms shatter into several pieces under the impact of the neutrons and thus release large quantities of energy. In fusion, on the contrary, the light nuclei of hydrogen, deuterium, and tritium fuse among themselves to form helium nuclei and release energy in the form of a neutron flux.

2. Deuterium and tritium are two isotopes of hydrogen, two first cousins of sorts, that are sometimes given the names heavy hydrogen and superheavy hydrogen. Unlike deuterium, tritium is not present in nature. It is radioactive and loses half of its radioactivity (half-life) every 12 years.

3. Europe devotes 400 million ecus (Fr2.8 billion) annually to research in thermonuclear fusion, versus spending of around \$200 million (Fr1.12 billion) by the United States and Japan. France (which participates in the JET to the extent of 20 percent) spends Fr340 million annually. Germany, two or three times more.

### Germany To Supply Cluster Detectors for Euroball Project

92MI0231 Bonn WISSENSCHAFT WIRTSCHAFT POLITIK 8 Jan 92 p 5

[Text] As part of a cooperative venture involving Germany, England, France, Italy, and Scandinavia, the German research groups (Bonn, Heidelberg, Cologne, Munich) in conjunction with the Second Physics Institute at Goettingen University under the direction of Professor Klaus-Peter Lieb will be supplying what are known as cluster detectors for the Euroball gamma spectrometer project. The Federal Ministry of Research and Technology (BMFT) has authorized funding for the construction of several detectors, costing 1 million German marks [DM] each, in the period 1992 to 1994. Cluster detectors consist of a honeycomb arrangement of seven pieces of germanium connected to a joint liquid nitrogen cooling system. They constitute almost the entire outer shell of the spherical Euroball spectrometer.

The detectors are used to measure gamma quanta (gamma radiation) energy. These measurements are the key to information about the shape of an atomic nucleus. The nucleus is so small, about  $10^{-10}$ cm (which means that a billion nuclei would have to be placed side by side to cover one centimeter), that observing it directly, for example, through an electron microscope is impossible. It can be "observed" by measuring energy because the forces in a microscopically small system can be calculated from the energy measured, and its shape can thus be inferred. The energies can only take on very specific values, which are termed excited nuclear states and are almost an image of the shape of the nucleus.

The short-wave, invisible gamma rays whose energy is measured are emitted as nonspherical nuclei rotate.

### JET's Controlled Nuclear Fusion Produces 2 Megawatts Energy

92WS0234C Duesseldorf VDI NACHRICHTEN  
in German 15 Nov 91 p 64

[Article by Peter Frey: "European JET Experiment Delivered 2 Megawatts; Controlled Nuclear Fusion

Delivers Energy for First Time; Reactor Possible in 50 Years at Earliest"; first paragraph is VDI NACHRICHTEN introduction]

[Text] VDI-N, Culham, 15 Nov 91—Europe's physicists have come a long way in getting closer to their goal of igniting the fire of the sun on earth in a controlled manner. For nearly two seconds "Joint European Torus" (JET) scientists generated a temperature of more than 300 million°C in a plasma of deuterium and tritium (heavy and superheavy hydrogen). Enough to overcome the ion's force of repulsion and release about 1.7 million MW of energy.

Although the champagne corks were popping in British Culham, the scientists themselves warned against too much optimism. To be sure, they may have been able to demonstrate that fusion is possible in a reactor. In the scientists' opinion, however, it will be at least another 50 years before countless problems involving details on the way to a working power plant are solved.

The Culham experiment was no stroke of luck. As early as the beginning of the year, the physicists had decided on a date, Friday of last week, and expressly invited a BBC television team as well as countless media representatives. But, because the British scientists on the JET project went on strike to draw attention to the low salaries they receive in comparison with many of their European colleagues, the controlled fusion demonstration did not take place until Saturday.

With cautious optimism, Martin Keilhacker, acting director of the JET project, stated on Tuesday of this week during the science press conference in Bonn: "The experiment that has taken place is an important step forward. But not until the plasma has burned for an hour will we have succeeded." This, however, will only be possible with the next generation of reactors. Nevertheless, the JET scientists have beaten their own world record with the production of 50 times as much fusion energy.

JET director Paul-Henri Rebut described their success as an "important milestone": "With these results, the hard work of many years has been rewarded. This confirms Europe's leading role in the field of fusion research." In Rebut's estimation, construction of the \$5 million experimental reactor, ITER (International Experimental Thermonuclear Reactor), (with a projected thermal output of 1,000 MW) is feasible.

Klaus Pinkau, science director of the Max-Planck Institute for Plasma Physics (IPP) in Garching near Munich, compared the JET breakthrough with the construction of an oven: "We now have the fire brick. But to build a proper oven, we need a lot more than that." The IPP participated decisively in the preparation of the successful fusion experiment.

The brilliant achievement in Culham was the chief topic of discussion at the annual conference of the Major Research Institution Study Group (AGF), of which the



IPP is also a member, on Wednesday of this week. In view of its critical financial situation, the officials of the institute now hope for bigger federal appropriations from the federal research minister.

Nuclear fusion is considered to be a nearly inexhaustible source of energy. Through nuclear fusion, 50,000 kWh of energy can be obtained from a single gram of fuel, as much as is released with the burning of six tons of coal. The fusion fuel, deuterium, is available in earth's oceans in practically unlimited amounts. The fusion energy in a single cubic meter of seawater is equivalent to the energy contained in all of the known petroleum reserves today. Lithium, from which the second fusion fuel, tritium, can be produced, is also available in sufficient amounts.

Nuclear fusion releases the binding forces in the atomic nucleus. When a gas consisting of deuterium and tritium molecules is heated to a very high temperature, it changes its basic structure. Molecules break apart from one another, atoms lose the electrons of their shell, a confused mixture of ions—plasma—is produced. Of advantage to physicists: Since the components of this particle chaos carry electrical charges, they can be confined in a magnetic field cage. A venture that becomes increasingly more difficult as temperatures rise. Since the positively charged nuclei of atoms avoid one another whenever they approach one another, temperatures of at least 100 million°C are needed to release the fusion energy even under the best of circumstances.

Of all the imaginable pairs of light atomic nuclei, the fusion of deuterium and tritium requires the lowest ignition temperature and at the same time yields the greatest amount of energy.

During the fusion of the hydrogen isotopes, an energy-rich helium nucleus (particle) is formed. At the same time, a fast neutron that carries 80 percent of the energy is released. In a fusion reactor of the future these lithium neutrons should produce the required fuel, tritium, and above all simultaneously generate heat and then current.

Of course, in case of error or accident, a fusion power plant could hardly melt down (because of its extremely low density, a fusion plasma has the approximate output density of a household light bulb), the heaviest hydrogen isotope, tritium, is radioactive. During decay (a half-life of 12.3 years), beta rays, which can be easily blocked and cannot penetrate human skin, are generated. The hydrogen isotope is only dangerous if it is inhaled by people or ingested with food. So the safety of such a power plant would probably primarily depend on the encapsulation of the tritium mass, which it is estimated would be a few kilograms in a future reactor. In last Saturday's experiment the scientists employed a rarefied fusion plasma, 14 percent (about 0.2 gram) of which was tritium, to keep activation of the surrounding elements as low as possible. This is why they will be doing further work on this in Culham after a pause of as little as a few weeks. A fuel ratio of 1:1 should be instituted as of 1996.

The construction of the combustion chamber poses technical problems. The steel housing becomes radioactive from the fusion neutrons and must be replaced about once every seven years because of the high level of contamination. The half-life values for the steel employed today range up to 100 years. During the approximately 30-year life of a fusion reactor about 4,000 m<sup>3</sup> of moderately radioactive and about 2,000 m<sup>3</sup> of highly radioactive metallic waste are produced. Figures that are endowed with "a high degree of accuracy," said Juergen Raeder, who is responsible for safety concerns at the IPP in Garching.

Plasma physicist Raeder, who is already thinking about possible hazards involved in the next generation of fusion projects, like NET (Next European Torus) or ITER, admitted: "Even though the fusion waste produced by a future reactor will be radioactive for a shorter length of time, it will nevertheless have to be permanently stored." If they succeed in replacing the steel housing used today, which contains a relatively large amount of nickel, with vanadium alloys, the radioactive reactor housing could be temporarily stored and, ideally, used again within a generation.

#### **German Nuclear Fuel Processing Plant to Close**

92MI0248 Bonn *TECHNOLOGIE-NACHRICHTEN*  
MANAGEMENT-INFORMATIONEN in German  
17 Jan 92 pp 11-12

[Text] On 10 December 1991, the federal government, represented by the Federal Ministry of Research and Technology, the land of Baden-Wuerttemberg, represented by its Ministry of the Economy, Small- and Medium-Sized Enterprises, and Technology, the Karlsruhe Nuclear Research Center GmbH (KfK), the Karlsruhe Reprocessing Plant Company mbH (WAK GmbH), and the German Nuclear Fuel Reprocessing Company (DWK) signed a general agreement on the decommissioning and final closure of the Karlsruhe Reprocessing Plant Company (WAK). Total costs are currently estimated at around 1.9 billion German marks [DM] over the total 12-year term for the project, DM1 billion of which are being contributed by the German electricity generating corporations via the DWK. The actual work of planning, decommissioning, and disposal will be carried out mainly by the plant's present operator, WAK GmbH, on behalf of KfK, which is responsible, as owner of the plant, to the federal and land governments for the project's implementation.

WAK was established over the period 1964 to 1970 on behalf of the federal government by the then Nuclear Research Company (now KfK GmbH) at an overall cost covering the plant itself and subsequent extensions, of around DM200 million. The plant was subsequently operated by the Nuclear Fuel Reprocessing Company mbH (GWK), which was set up by the Bayer, Hoechst, Gelsenberg, and Nukem companies, who had their costs refunded by the federal government. In 1981 WAK GmbH, a DWK subsidiary, succeeded the GWK; from

1982 WAK was funded by industry via the DWK, which itself was founded in 1977 by 12 German electricity generating corporations.

Since 1971, WAK has reprocessed around 208 tonnes of nuclear fuel using the Purex process, in which nitric acid is used to leach the fuel out of the fuel rods after they have been cut up, and the valuable substances uranium and plutonium are then extracted using an organic solvent and recovered. The radioactive fission products then remain as a concentrated liquid solution. An annual throughput of 35 tonnes was planned for the plant, which was also successfully used as a test-bed for KfK's technical developments. Following DWK's cancellation of the operating agreement. The reprocessing plant ceased to function on 31 December 1990.

An integral part of the present agreement on the plant's decommissioning is provision for disposal of the radioactive waste, in particular the highly active liquid waste stored in WAK. This is to be transported to the PAMELA vitrification plant in Dessel, Belgium, where it will be encased in glass for ultimate storage, using an established process. Disposal by this process requires the building of suitable on-site delivery stations for highly active waste both at WAK and at the PAMELA plant, and the availability of suitable transport containers.

The decommissioning of WAK's facilities, including the planning and approval stages, the decontamination of facilities and buildings, the dismantling of the plant, and, finally, the conventional demolition of the buildings, will proceed simultaneously with waste disposal. Processes that have successfully proved their validity in nuclear technology are used in decontamination and generally reduce the dose rate for processing plants to such an extent that dismantling can be carried out through direct contact. Where this is not possible, remote-control equipment is used for dismantling as in the decontamination of two earlier reprocessing plants. Eurochemic in Belgium and Nuclear Fuel Services in the United States. Each separate partial stage in the entire process requires approval in accordance with the law governing nuclear facilities. Present estimates are that the project to create a green field site will take around 12 years.

#### **French Researchers Use Laser Isotope Separation Technique for Uranium Enrichment**

92WS0286A Paris LE MONDE in French  
21 Jan 92 p 14

[Article by Jean-Francois Augereau: "France Is Well-Positioned in Enriched Uranium Battle"]

[Text] Prime Minister Edith Cresson's visit of 20-21 January to Grenoble (Isere), Pierrelatte (Drome), and Saclay (Essonne) attests to the government's interest in two strategic sectors of the French economy: The chronically weak computers and electronic components sector, which the recent creation of a powerful group centered on Thomson and CEA-Industries (LE MONDE 20

December 1991) is expected to bolster, and that of the enrichment of uranium for nuclear power generating plants.

Despite its success (1), the uranium enrichment sector is not as prosperous as it could be. The resurgence of new nuclear power plant construction worldwide is seemingly not imminent and the market is consequently tight. The more so in that the United States, which had at one point abandoned the development of its enrichment techniques, now wants to be in a position—in the words of former American Secretary of Energy John Herrington—to "retake the market from the French," and the Soviets, in their quest for foreign currency, are offering enriched uranium at well-below-market prices.

Survival in this market therefore depends on evolving as of now and using modern enrichment techniques—techniques capable of soon superseding the gaseous diffusion methods Eurodif and the United States have been using for years, as well as the ultracentrifugation methods on which President Saddam Hussein had cast covetous eyes for the building of a nuclear arsenal, and which Japan and Urenco in Europe have developed for civil purposes.

This new process, which has been dubbed SILVA (2), is now emerging from its laboratory stage. It combines light and matter. It utilizes subtle phenomena in which lasers play the leading role and become capable of separating out of a uranium atom soup, almost one by one, those (fissionable uranium 235) atoms that are usable—though ever so rare—in nuclear power plants, from the all-too-available (uranium 238) atoms present in abundance in the ore.

#### **Battle of the Lasers**

For the past 10 years or so, the United States has bet its all on this [laser isotope separation (LIS)] technique, which it considers the most efficient, the least guzzler of energy of all those in existence, and capable—it argued in 1985—of reducing the price of the finished product by half. And in June 1985 it went so far as to take the plunge of abandoning, virtually overnight, the ultracentrifugation techniques, in which it was incontestably the world leader and on which it had already spent \$3 billion. This provides some idea of the stakes in this uranium enrichment race, which will not become evident until the beginning of the next century.

Aware of this coming economic battle, the French have not kept their weapons at parade rest, and today they are emerging as the world's number two in this laser method of uranium enrichment. At the Saclay Nuclear Studies Center, which Mrs. Cresson will be visiting, teams have been working for several years on the development of this process. It is laborious, difficult, complex work, a guzzler of intellectual resources and demanding of industrialists, who, like the manufacturer of Cilas lasers, are central to the project.

It is a long road from a laboratory experiment designed to confirm the validity of the process, to the development of the physics involved, to the development of reliable equipment capable of opening the way conclusively to the construction of an industrial production unit. But everyone progresses, and Mrs. Cresson will be able to "physically touch" the little pilot SILVA-2 pilot installation in which Saclay's teams have succeeded in producing 10 grams of enriched uranium in a little over two hours.

Ten grams is not much when one thinks of the tons that Eurodif is capable of producing. But this modest stage has been determinative, since it has demonstrated the feasibility of the process and the ability of the French to control the reliability of the lasers needed for this undertaking. The desired result was not achieved, but confidence is now the rule: 30-watt industrial lasers are now operating without a problem. Others of 100-watt capacity, have been operating for hundreds of hours now, and in the laboratory, 230-watt units have taken their first steps.

This is still insufficient, the objective being 400 watts and 1,000 hours of operation without a malfunction, in the hope of launching a production unit worthy of the name. We are advancing, therefore, in small steps, preparing for the next phase: A 250-million-franc[Fr] higher-performance pilot (ASTER [expansion not provided]) targeted for 1995-1996, and an industrial plant, to be installed at Pierrelatte between 1996 and 2001 and to be capable of producing not grams but kilos of enriched uranium.

In short, a capability of pursuing the Americans, who are capering at the head of this technique, which they already have and in which, according to the French, they enjoy "a lead of approximately five years." We cannot afford, therefore, to throw in the sponge, expecting it to bounce up and recapture the enriched uranium market. But the race cannot be run without resources that are difficult to obtain during a period of economic austerity. The budgets for the SILVA program are indeed tight when one considers that the United States invests Fr900 million annually in this field, and the Japanese between Fr500 and Fr600 million, and that the French, with only Fr300 million, are still hanging in there. Will Mrs. Cresson be receptive to this argument?

#### Footnotes

(1) Eurodif currently provides one third of the world's enrichment services. The United States provides only half the total. Their installations are growing old, uneconomic, and ill-suited to a tight market, characterized as it currently is by sizable production overcapacity.

(2) SILVA [for Laser Isotope Separation of Uranium Vapor], or ALVIS in English [as published].

### CERN Presents Hadron Collider Project

92WS0298B Paris AFP SCIENCES in French  
12 Dec 91 p 16

[Text] Geneva—The European Particle Physics Laboratory presented plans for a new piece of equipment—the Large Hadron Collider (LHC), to be used in research on high-energy physics—during a special session on 19 December. The laboratory is part of CERN, the European Nuclear Research Center.

Scientists believe that the machine will enable them to delve more deeply into the structure of matter and to recreate the conditions that existed in the universe one millionth of a millionth of a second after the hypothetical Big Bang.

Professor Carlo Rubbia, the general director of CERN, estimates that the project will cost 2 billion Swiss francs (7.6 billion French francs [Fr]). It should not, however, raise the dues of the 16 member states.

It will take about five years to build and install the LHC. The machine is a superconducting particle accelerator in which protons will collide at energies higher than ever before achieved. The LHC will not require extensive civil engineering work since it will be installed above CERN's Large Electron-Positron Collider (LEP). The LEP is located in a long, 27-kilometer circular tunnel near Geneva, straddling the French-Swiss border.

### Superconductivity

#### Tuebingen University Superconductivity Project Extended

92WS0232A Duesseldorf HANDELSBLATT in German  
19 Dec 91 p 20

[Text] Duesseldorf, 18 Dec—The discovery of high-temperature superconductivity five years ago marked the onset of a frenzied round of research activity. Significant advances have been made in terms of material properties, such as crystal structure or electronic properties. However, there remain a number of open questions that could help to further explain the basic mechanism of superconductivity in these materials.

"There are various known and proven processes today for producing these superconductors," reports physicist Rudolf Huebener, who is involved in the "High-Temperature Superconductivity (HTSL)" research project as holder of the chair for experimental physics II at the University of Tuebingen. "What we are lacking, however, is a basic understanding of how superconductivity works in these materials."

The federal minister for research and technology (BMFT) recently extended the "HTSL" joint project for another three years. The focal points for the Tuebingen scientists are solid-state chemistry, crystalline structure analysis, and thin-film technology. The research is being conducted in conjunction with the Tuebingen Institute

for Inorganic Chemistry, which is headed by Professor Sibylle Kemmler-Sack. Other partners are working groups at the Universities of Stuttgart, Erlangen, and Regensburg.

#### Functional Testing With Scanning Electron Microscope

One focal point at the chair for experimental physics II is thin-film technology and microstructuring for the production of microelectronic components and circuits based on new high-temperature superconductors. In addition, low-temperature scanning electron microscopy has established itself as a new diagnostic method for functionally testing HTSL electronics. This method makes it possible to identify defective points with high local resolution. For applications in microelectronics, monocrystalline films—especially those made of the high-temperature superconductor YBaCuO—are of interest.

#### Success in Microstructuring

For about a year now, an installation based on the so-called magnetron atomization process has been in operation, which was constructed as part of a doctoral thesis and several dissertations. At 77 Kelvin, the boiling point of liquid nitrogen, critical electric current densities of more than  $10^6 \text{ A/cm}^2$  are routinely achieved. In addition, microstructuring has been developed.

Since only recently, the scientists have had at their disposal a self-developed ion beam etching technique that allows them to produce very narrow conducting paths of up to  $2 \mu\text{m}$  in width without impairment to the superconductive properties. This type of microstructuring is an essential precondition for the production of microelectronic components with high-temperature superconductors.

Recently, monocrystalline film packages in particular have been under study. "These are artificial structures that are of particular interest for basic research and for understanding superconductive properties and the underlying mechanism," explains Rudolf Huebener. In these film packages, a certain number of elementary cells of superconductive materials, such as YBaCuO, and of another material, such as an electrical insulator, are alternated in stacks. The goal of this is to find new materials with new electronic properties.

Superconductive quantum interference devices based on high-temperature superconductors have been produced in various laboratories for some time now. These interference devices are the most sensitive measuring probes for detecting magnetic fields at great distances. In addition, they can be used to detect derived electromagnetic values, such as electric current intensity and electric voltage, with a very high level of sensitivity.

Superconductive quantum interference devices have long been made out of classical superconductors. Professor Huebener: "Operation at 77 Kelvin, the boiling point of liquid nitrogen, by using high-temperature

superconductors will greatly expand the area of application." Important areas of application for this technology are medicine (magneto-cardiography), geological prospecting, and material science.

The working group in Tuebingen is intensively involved in developing interference devices in which the Josephson contact is realized by individual grain boundaries in a monocrystalline YBaCuO film. Thus far, the greatest sensitivities have been achieved with this design principle.

The Tuebingen process of low-temperature scanning electron microscopy has met with a great deal of interest for applications with high-temperature superconductors. In this process, the superconductive film configuration is charged with an electric current and simultaneously scanned off at the superconductive operating temperature with the electron beam of a scanning electron microscope. The electron beam acts as a local heat source and is used to sample the temperature sensitivity of the film configuration with high local resolution.

An electric voltage signal occurs during the scanning-off process at all weak points, since at these weak points superconductivity cannot be maintained under the selected operating conditions. The low-temperature scanning electron microscopy process has already been used to make important new discoveries in optimizing methods for film production and film microstructuring.

### Telecommunications

#### Thomson Launches GaAs Circuit for Broadband Communications

92BR0095 Paris *ELECTRONIQUE INTERNATIONALE* HEBDO in French 14 Nov 91 p 44

[Text] The Thomson Composants Microondes (TCM) circuit has been designed for applications in broadband optical communications.

Within the framework of its agreements with Vitesse Semiconductor, TCM has developed a  $64 \times 64$  gallium arsenide (GaAs) switching matrix with a bit rate of 200 Mbits/sec. This circuit, referred to as VSC864, integrates 30,000 gates on a chip of  $13.77 \times 7.73 \text{ mm}$  and is apparently the largest standard GaAs circuit on the market.

The VSC864 has been designed for telecommunications applications, especially for the implementation of protection switches for fiber optic links. Telecommunications links are, in fact, routed through main nodes, in which dispersion often occurs. The VSC864's high data rate capacity makes it particularly suitable for applications based on optical telecommunications protocols such as SDH [synchronous digital hierarchy] STM-1 (in Europe) and Sonet STS-3 with a bit rate of 155 Mbits/sec (in the United States).



However, the VSC864 can also be used in computer applications. For instance, a crossbar switch can be implemented advantageously in place of the bus in a multiprocessor system to handle communication between the processors and the main memory. The main advantage of this switch is that it can handle simultaneous transactions between several processors and the memory.

Moreover, the capacitive load on each port of the processor or memory gate is minimized for an input of 1. Furthermore, access time with an interconnection of this type is much shorter than with a heavily loaded bus.

#### Design Center for GaAs ASIC's

Still within the framework of its agreements with Vitesse, TCM has just opened a design center for GaAs digital ASIC's [application-specific integrated circuits] in Orsay, a southern suburb of Paris. This center has been approved by Vitesse.

#### ISDN Introduction in EC Analyzed

92BR0099 Amsterdam COMPUTABLE in Dutch  
15 Nov 91 p 7

[Article by Yvonne Ton: "European ISDN Encounters Several Obstacles"]

[Text] London—By 1 January 1994, integrated services digital networks (ISDN) will be available in Belgium, Denmark, France, Luxembourg, and the United Kingdom for all business users. The other EC countries will follow suit: Within a year or two, Ireland, Germany, and Portugal will reach this stage and the remaining four member states—the Netherlands, Italy, Spain, and Greece—will provide access to ISDN for 60 percent of its business users.

This is the picture which is presented in the "European ISDN Atlas," a survey carried out by Ovum en Fischer & Lorenz for the European Commission. The report offers an extensive overview of the current state of affairs and expected developments in the field of ISDN in the various member states.

The Ovum report states that ISDN is being implemented in accordance with the plans outlined in the Memorandum of Understanding signed by the 12 EC member states in 1989. According to this agreement, they are committed to develop a European ISDN network by the end of 1993.

The extent to which the different European countries are implementing ISDN varies from acquiring initial experience through pilot projects to immediately setting up commercial services which cover the entire country. In the Netherlands, PTT Telecom is starting its ISDN service on 1 December in the cities of The Hague, Amsterdam, Utrecht, and Rotterdam, following a two-year pilot project in the latter.

Despite rapid developments, the "ISDN Atlas" acknowledges that several obstacles still have to be overcome before a uniform ISDN infrastructure is implemented for the whole of Europe. The geographical distribution of ISDN in the member states will initially be limited and there are not enough links with foreign countries. Moreover, most European countries use different standards, which, by the end of 1993, should be blended into a common "Euro-ISDN" standard. Rate structures differ greatly from country to country and ISDN equipment is still expensive and available on a limited scale only.

#### France, Japan To Cooperate in HDTV Development

92BR0122 Paris ELECTRONIQUE INTERNATIONALE  
HEBDO in French 28 Nov 91 p 6

[Text] The agreement on compatible production standards between both countries could give impetus to HDTV [high-definition television] developments.

The HDTV saga is consistently upholding its reputation of being rich, complex, and whimsical. After the European Parliament surprise vote on a highly controversial British Conservative amendment tending to oppose the adoption of HDMAC as the single HDTV standard for Europe, France and Japan have signed an agreement in the field of HDTV production standards.

During his visit to Tokyo, Post and Telecommunications Minister Jean-Marie Rausch and his Japanese counterpart Hideo Watanabe announced that they would set up a working group before the end of the year.

#### Sixty-Six Hours a Week of HDTV Programs

The aim is to jointly study and develop a converter for the European and Japanese systems. The project will involve industry people from both countries. Europe has its own 16/9-format, 1250-line image standard, whereas the Japanese use a system based on 1125 lines. Could this French-Japanese "pas de deux" be the basis of much wider maneuvering in the budding "TV of the future" market? In any case it should be said that it was the MAC Paquet GIE [economic interest group], involving Thomson Consumer Electronics, Philips, TDF [French Telecasting], and British National Telecommunications, which first took the initiative by starting negotiations, a few weeks ago, to sell D2-MAC licenses to Japanese industry.

In Japan, the audiovisual industry and radio networks are moving ahead at full speed. They have just launched a 66 hour-week HDTV program relayed by the BS3-B satellite and featuring mostly sports programs, concerts, and plays. A consortium was formed around this project, including the NHK national TV channel, Sony, Hitachi and Panasonic, among others.

### SGS-Thomson's HDTV Circuits Described

92BR0124 Paris *ELECTRONIQUE INTERNATIONALE*  
HEBDO in French 28 Nov 91 p 28

[Article by Elisabeth Feder: "SGS-Thomson Enters High-Definition Television (HDTV) Market"]

[Text] With a set of four circuits for decoding D2-MAC signals, SGS-Thomson considers that it can provide the optimum long-term solution.

A 0.8-micron CMOS [complementary metal-oxide semiconductor] technology for consumer circuits, a single 5-volt power supply, and a total consumption of less than 2 watts: These are the main features of a set of four integrated circuits which SGS-Thomson will be offering for decoding D2-MAC signals. To highlight its arrival on the enhanced television market, the company preferred indeed to optimize the different functions separately in order to attain high-level quality. For example, by developing a specific analog-to-digital converter for the baseband MAC input in order to guarantee a "pure" signal. Three additional integrated circuits, designated STV-3810, STV-3820, and STV-3830, ensure MAC signal acquisition, video processing, and sound and data processing, respectively. The complete separation of audio and video parts should allow an easy transition to the HD-MAC high-definition television [HDTV] standard of the future. Indeed, only two of the four integrated circuits require minor modifications to achieve an HD-MAC-based decoder for the function of restoring the passband

The STV-3800 analog-to-digital converter is a real 8-bit converter that contains a gain control circuit and a local oscillator. Its characteristics are an alignment control of approximately 1 LSB [expansion not provided] and an amplitude control of approximately 0.3 decibel, a signal-to-noise ratio of approximately 40 decibels for a 9-megahertz frequency response, and an harmonic distortion of less than 50 decibels. The passband available for the signal is thus fully conserved, guaranteeing excellent quality for the signal sent to the video processor.

The MAC acquisition circuit, designated STV-3810, ensures the functions of recovering the clock and synchronization signals as well as restoring the white or black reference levels, this information being transmitted on line 624. It also controls the MAC signal's amplitude and gain.

Video processing, on the one hand, and sound and data processing, on the other, are fully ensured by two dedicated components. The STV-3820 video processor contains a memory for decompressing the luminance and chrominance signals, as well as a digital filter followed by a D/A converter for a good restitution of the RGB [red-green-blue] signals at the output. This component also handles the conversion to the wide 16/9 format, as well as the decoding of the video part. The coding/decoding method chosen comprises two cutoff points, one in the luminance and the other in the chrominance

section; the two sections are then inverted in time sequence for transmission. The coding cutoff points vary on all lines according to a random-sequence generator and the decoder must restore the incoming signals, after reception of the appropriate data transmitted on line 625. The set of circuits implemented in a D2-MAC decoder, particularly at the level of the video processor outputs, can be completed in order to handle RGB or composite video signal outputs.

Another particular feature of the D2-MAC standard is its potential for transmitting up to four compact disc quality sound tracks, or eight lower-quality tracks (for commentaries or data). The STV-3830 fully digital sound processor handles up to four mono tracks or two stereo tracks. It integrates a special filter to ensure oversampling of the commentary tracks with significant noise suppression and attenuation exceeding 60 decibels, outside the useful band. Mixing the main sound with the commentary tracks is possible at the output, without deterioration at the performance level. In teletext mode, the STV-3830 decodes packets transmitted during the frame return interval by the STV-3810.

### Production To Begin in Mid-1992

The circuit prototypes currently available have been made in 1.2-micron CMOS technology except the analog-to-digital converter, for which SGS-Thomson chose its bipolar CMOS (BiCMOS) technology. The circuits' total consumption could thus be reduced to less than 2 watts, including 600 milliwatts for the converter. A new version of CMOS components with 0.8-micron structures is being finalized and production is slated to start by mid-1992. In a world market for approximately 500,000 decoders, including external "black boxes" as well built-in decoders in television sets, SGS-Thomson is aiming at sales of several tens of thousands as of the first year. In order to be competitive, the company plans to fall into line with the prices of competing solutions, notably those of ITT and soon Philips. A complete decoder is already available for the evaluation of the set of circuits.

### EC Commission Approves Eight HDTV Projects

92BR0130 Antwerp *DE FINANCIËLE*  
*EKONOMISCHE TIJD* in Dutch 23 Nov 91 p 12

[Text] The EC Commission and the Media Investment Club (one of the sections of the EC's Media program) will support eight projects which are to be produced in the European HDTV standard. A total of ECU1 million will be made available for the projects.

In April 1991, the Investment Club launched a call for proposals for new projects called HD Media. Three had already been approved, bringing the total to 11. Current applicants include "L'Affaire Seznec" (a coproduction of TF1 [French first TV channel], GMT Productions, and SFP) and "Amahl and the Night Visitors," a Thames

Television production. One of the productions which has been approved, "Le Musee Imaginative," is a Belgian-French coproduction.

The investors have also decided to organize training courses on HDTV for professionals.

Earlier this week, an agreement was reached at the European level between independent producers of productions using the HDTV standard. The Association of Independent Producers of High-Definition Programs is an association comprising Thames Television (UK), Synergetic Communications (France), Com 4 (Spain), RTI (Italy), and Unitel (Denmark). European Media Commissioner Dondelinger has already recognized the organization as a party to be consulted. The association also requested the opportunity to participate in the Memorandum of Understanding [MOU] which is being prepared. This MOU aims at harmonizing the needs of HDTV software and hardware manufacturers and is still being negotiated.

#### EC: Mobile Phone Circuits Described

92BR0141 Paris *ELECTRONIQUE INTERNATIONALE* HEBDO in French 5 Dec 91 p 19

[Article by Didier Girault: "Three Circuits and One Module for GSM Sets as of 1994"]

[Text] Philips Semiconductors is getting ready to launch a set of nine circuits for the all-European digital mobile phone (GSM [Special Mobile Group Standard]), with a much more integrated model being studied.

All-European GSM-based digital mobile telephony should really take off in 1992 and the number of installed sets should reach about 4 million by 1994. Due to the system know-how acquired by the German subsidiary Philips Kommunikations Industrie (PKI), which participated in the development of the GSM standards, and also due to mastery of the latest CMOS [Complementary Metal-Oxide Semiconductor] and BiCMOS [bipolar CMOS] technologies (SaCMOS [self-aligned contact MOS], a low-voltage CMOS process with EEPROM [electrically erasable programmable read-only memory] cells which is twice as dense as the conventional CMOS, and Qubic, state-of-the-art BiCMOS technology with a cutoff frequency of 13 GHz), Philips Semiconductors is getting ready to make its appearance on this market with a set of nine circuits, including two for coding/decoding and signal processing, and six (including one redundant) for the HF reception portion.

This system will include, in particular, a baseband processor which was presented at the Comonic 91 show: this circuit will replace the two signal processors that are used in the majority of the current versions of GSM mobile phones. This will decrease power consumption, a key parameter in mobile telephony. The first versions for base stations (PCF 5080) and mobile stations (PCF 5081) are already available in conventional CMOS and will be available in 1-micron SaCMOS as of late next

1992 (according to Philips, this is equivalent to a 0.5-micron CMOS). Peter Baumgartner, president of the Swiss subsidiary Faselec and in charge of integrated telecommunications circuits at Philips, made it clear moreover that the modem section—including the analog/digital and digital/analog conversion unit—will also be integrated on a chip manufactured in SaCMOS. The resultant circuit will be included in the set which should be available by late 1992.

The HF reception portion is the most difficult to integrate. It currently has 10 percent integrated circuits and 90 percent discrete circuits. By the end of 1992, integration will, however, have had its effect; the reception portion should include 40 percent integrated circuits and 60 percent discrete ones. In practice, it will contain the following parts: A SaCMOS synthesizer, a reception circuit (QuBic), a (bipolar) emitter/receiver, a (bipolar) mixer, a logarithmic amplifier, a Prescaler scale changing circuit (QuBic), and a power module.

Philips Semiconductors does not want to be halted along such a good path. The company is therefore continuing its integration work: A complete set with three integrated circuits and a power module should see the light of day by 1994. The baseband processor and the conversion unit (analog/digital and digital/analog) would then be integrated on a single chip made of 1-micron SaCMOS technology and would only require a 3-volt power supply, which should make it possible to limit consumption. Power consumption of the 16-bit system microcontroller will also be lowered through the utilization of the same technology and an optimized architecture. By then, the receiving unit should only include one integrated circuit and a power module, both implemented in QuBic technology. Only a few filters cannot be integrated in this unit because of the temperature drift they would cause on a chip that includes power elements. But it will be difficult to push integration much further. In fact, according to Peter Baumgartner, it is out of the question to integrate the HF receiving portion with the decoding and signal processing units: "This would not be an economically feasible solution because a QuBic process with 20 masking steps would have to be used to implement the circuit, whereas signal processing and conversion require only 10 to 12 masking steps." The most integrated solution will include two separate modules.

#### A Digital European Cordless Telephone (DECT) Set for Late 1992

"The circuits for the 1.8-GHz Digital European Cordless Telephone (DECT) are already in great demand. We are therefore working on the development, by late 1992, of a complete 3-volt kit comprising a codec, a burst-mode controller, and a microcontroller. These components are currently being developed in 2-micron SaCMOS and will be available in 1-micron SaCMOS by late 1992," announced Peter Baumgartner. The key element of the kit, i.e., the direct frequency conversion circuit, is in the final test phase with Philips Semiconductors benefiting in this field from its experience in the development of

similar circuits designed for electronic mail services. This circuit will be developed using the QuBic process.

The emitter/receiver portion will always be available in the form of a unit of discrete bipolar components, whereas the "scale changer and synthesizer" solution that was developed for electronic mail systems will be adapted to DECT.

The next generation of DECT sets should include a circuit that integrates all the functions with the exception of the local oscillator and the transmitter. The latter could also be integrated in the main circuit; this would depend on the applications and thus on the required output power.

#### **Italian, Soviet Telecommunications Company Established**

92MI0145 Milan *L'INDIPENDENTE* in Italian  
27 Nov 91 p 16

[Article by Susanna Petruni: "Italcable, Telespazio Agreement with Moscow for Soviet Direct Dialing"]

[Text] The first Italian-Soviet telecommunications company resulting from an agreement between Italcable, Telespazio, and the Soviet company Astra is called Astelit.

The protocol of agreement to hand over 50 percent of the new company to Italy (25 percent Italcable, 25 percent Telespazio) will probably be signed today at IRI [Institute for the Reconstruction of Industry] headquarters by the managing directors of these two STET [Turin Telephone Finance Company] companies, Paolo Benzoni and Raffaele Minicucci, and by the Soviet Rodimov.

Astelit will provide telecommunications services with direct dialing systems throughout the world and in various cities of the USSR. During its first two or three years, the company should reach revenues of approximately 20 billion lire.

Operations will begin in Moscow and St. Petersburg and then extend to all of the Soviet Union.

Italcable and Telespazio will use the Soviet Raduga satellite to carry out the project, while the first so-called Earth telephone base will be in Fucino, Italy (belonging to Telespazio) and later in Moscow and St. Petersburg.

ASST [State Telephone Services Agency] will also participate in the project with its transmission systems.

The initial plan is to provide services for international companies present in the USSR and of course, tourist and hotel facilities. It should indeed be noted that direct calls cannot be made abroad, nor can calls be made between one city and another in the Soviet Union.

All telephone calls pass through a complicated booking service, with often uncertain results. With Astelit, Italy will become the Soviet Union's principal telecommunications partner.

This project falls within the large development plans that STET, IRI's holding company, has developed for the Soviet Union. Italcable and Telespazio are part of the STET group.

The global plan christened "Trans Soviet Line" provides for the creation of a telecommunications network to connect the USSR with the Far East and Europe.

The manufacturing part of the program has been assigned to Italtel which is constructing a factory to manufacture digital systems on Soviet territory.

Moreover, the agreement will enable the Russian company Astra, which will hold 50 percent of the Astelit packet and is specialized in supplying electronic equipment for the defense sector, to convert back to civil production.

#### **France: Thomson Launches Videocommunications Branch**

92BR0164 Paris *ELECTRONIQUE HEBDO* in French  
19 Dec 91 p 9

[Article by Stanislas du Guerny: "Thomson Broadband Systems Launches its Operations"]

[Text] Specializing in cable videocommunications, Thomson Broadband Systems starts up its industrial operations in January 1992.

Continuing its search for new opportunities—necessary due to military budget restrictions—last July, Thomson CSF announced the founding of a unit, specializing in cable videocommunications. Called Thomson Broadband Systems, located on the point of Vernis in the technical center of Brest-Iroise, it is now entering the operational stage; it will start operations in January 1992. Over three years, 130 million French francs will be invested in the new factory. "The market which interests us is the cable networks in cities and at the European level," explained Thomson Broadband Systems management. The new fiber optic transmitting equipment will be developed with the assistance of Thomson's electronic research laboratory at Rennes. The Joint Center for Television and Telecommunications Studies (CCETT) is also one of the main scientific partners in this new operation; its products may require the consent of France Telecom.

"By 1995 our staff manpower will consist of 165 people," announced Christian Joeckle, industrial director of Thomson Broadband Systems. However, the factory will start in a few days with a small team of 50 people, two-thirds of whom are engineers or senior technicians. Some 12 percent of the small- to medium-sized company's annual revenue will be devoted to



research and development. New product research will be carried out either in the internal laboratory or within the group. For all that, Thomson Broadband Systems intends to award its cabling, card assembly, sheet metal fabrication, and mechanical components manufacturing to independent contractors.

The arrival of the company in the Finistere region has renewed the spirit of the people of Brest. During the last five years, Thomson CSF's manpower in the region has been reduced from 2,200 to fewer than 1,400 employees.

### France: Internal Debates Delay Development of D2MAC HDTV Standard

92WS01654 Paris LE MONDE in French  
13 Nov 91 p 25

[Article by Michel Colonna D'Istria: "Disputes in France Delay Development of European Television"—first paragraph is LE MONDE introduction]

[Text] The laborious work of elaborating a directive on technical standards for satellite broadcasts is delaying development of the intermediate D2MAC standard and thus compromising the future of European high-definition television [HDTV], because timing has become a crucial factor for industry. In that context, the disputes within France over utilization of the Telecom 2 satellite are adding to the uncertainty...

How are consumers to be introduced to the television standards of the future—and thus induced to purchase replacements for the enormous number of television sets already installed? Let market forces do their work, say the commercial stations: When the consumer demands higher-quality images, we will offer them. But manufacturers and authorities in several countries—including France—disagree.

Europe in 1986 adopted a strategy of autonomy vis-a-vis the Japanese; it has fought for recognition in technical circles, and it has invested in a technology, HDMAC: Philips and Thomson have a 20 billion French franc [Fr] joint program, Thomson receiving Fr3 billion over a six-year period in French subsidies for research. This industrial policy thus needs to be consistently applied to regulations in this domain.

The real debate has crystallized around a satellite television directive currently being considered in the European Parliament. Since 1986, the intermediate D2MAC standard has been imposed on satellites with powerful broadcast signals by means of a directive that expires at the end of 1991. But those satellites have been through various changes, and the directive has been legally evaded, notably by Astra, the Luxembourg satellite. The Commission has thus proposed a new directive, to extend D2MAC to all satellites, with a clear timetable for conversion or at least "simulcasting," that is parallel broadcasting in D2MAC and Pal or Secam (LE MONDE of 5 September)

### Three Stages

The lobbying has been intense (LE MONDE of 6 and 28 June). Most opponents of the directive object to the strategy. They believe that in the short term the obligation to broadcast D2MAC saddles broadcasters and consumers with additional expenses without providing any real benefit. They also believe it is a risky gamble, because new digital HDTV technologies hatched in the United States will rapidly overtake it. This view is reflected in the very negative assessment of the directive made by the consumer protection commission of the European Parliament. The commission on economic and monetary affairs, which deals with the parliament's industrial policy, has taken a different position. On Thursday 7 November it adopted an amended version of the report prepared by French Socialist deputy Gerard Caudron. Though the most extreme laissez-faire formulations were softened, this close vote opens the way to a new compromise, without eliminating the final objective: Europe-wide HDMAC television.

It confirms HDMAC as the sole HDTV standard "except for totally digital technology." It also recognizes D2MAC as the sole standard for satellite broadcasting in the new 16/9 screen format which manufacturers are vigorously promoting. According to the report, all television sets with new-format screens—not those that are able to receive broadcasts by satellite or cable on the new standards, as the manufacturers had proposed—should be required to support D2MAC. Finally, it proposes a three-stage process by which television stations would make the transition to D2MAC or "simulcasting": 1992 for newly offered services, 1994 for pay television, 1996 for all the others.

This text will be submitted to the European Parliament on 20 November and, on that basis the Commission will offer its proposals to the Council of Ministers, which will make a final decision at its 5 December meeting. Between now and then, bargaining in the corridors will continue over several points that have not yet been clarified: the aid—mentioned but not guaranteed—which the Commission has requested to lure the broadcasters and "sweeten the pill;" and signing of a "memorandum of understanding" (the famous "MOU"), which by committing all the players to concrete steps implementing the new standards would be a necessary counterpart to the directive, from the Commission's point of view.

### Canal Plus

Within France, the debate was recently rekindled in connection with a satellite to be launched in December that probably will not be affected by the directive. Telecom 2, having relayed broadcasts of the Olympic Games from Albertville, is now getting a "bouquet" of specialized stations such as Canal J, Canal Jimmy, Euromusique, TV Sport, etc. These stations are controlled by the cable operators and Canal Plus. Several months ago, it was expected they would broadcast in

D2MAC, thus proving that France and Canal Plus were committed to the new standard.

Now Mr. Andre Rousselet has let it be known he wanted the stations to broadcast in Secam on Telecom 2. The head of Canal Plus has decided that given the lack of 16/9-format programs and receiving equipment, he must broadcast in 4/3, and under such conditions D2MAC is on balance a commercial liability. Mr. Rousselet, noting the widespread opposition of European broadcasters to the directive, says he would prefer to see efforts focused on providing incentives, starting with the pre-Europesat and Europesat satellites.

In 1994 and 1996, those satellites will replace the faltering TDF1 and TV Sat and assure a special European niche for HDTV. But not all of the financing has been arranged: Though France, with unwavering support from Canal Plus, has certainly agreed to finance five pre-Europesat channels, German broadcasters are dragging their feet, preventing Bundespost Telekom from making commitments without assured customers.

The position taken by Canal Plus has discomfited the authorities and France Telecom. They see it as a precedent that other opponents of the directive will surely follow. As one specialist on the HDTV issue sums it up: "D2MAC is a sitting duck just now. Unless a clear direction is established quickly, D2MAC is finished. And that will probably mean the demise of HDMAC, despite all the reassuring statements."

In reality, Mr. Rousselet's position—backed as it is by some reasonable arguments—holds another manifest advantage for Canal Plus, albeit one that has not been put forward much. Broadcasting in Secam, Telecom 2 should be able to use special decoders controlled by Canal Plus for its pay stations, whereas broadcasting in D2MAC would help build a more technically and commercially open pay TV system in France. Pay TV is a potentially large market (LE MONDE of 8 November), and Canal Plus has no intention of helping its competitors gain access to it. The new standards upset existing arrangements: That is why people are getting upset and challenging them.

#### Better Image

The MAC family of standards, by separating luminance, chrominance and digitized data signals from the sound during transmission, improves the quality of both television image and sound. D2MAC, already available—it is used on the Paris cable network and TDF1, for example—offers the possibility of using the new "16/9" format instead of the "4/3" format that corresponds to the ratio between width and height of current television screens. The new 16/9 television sets permit a broader linear sweep of the electron beam that forms the image, while the more rectangular format is closer to the shape of the human visual field and cinema screens.

When combined with the Eurocrypt coding standard, D2MAC is particularly well adapted to pay TV stations.

Broadcasts in HDMAC, which offer true high-definition images (doubling the number of lines per image), are expected to begin in 1995, after being tested in 1992 at Albertville. They could still be received on D2MAC equipment, but with some loss of quality.

#### Results of EC Telecommunications Council Analyzed

92WS0167G Brussels EUROPE in English  
4-5 Nov 91 pp 9-10

[Article: "(EU) Telecommunications Council: Common Position on Leased Lines. Resolution on the Development of Satellite Telecommunications. Position in Favour of a Common International Prefix. Positions on HDTV Drawing Nearer"]

[Text] Brussels, 04 Nov 91 (AGENCE EUROPE)—The Telecommunications Council, meeting on Monday under the presidency of Mrs. Hanja Maij-Weggen, covered most of the items on its agenda in the morning and then spent lunch and its afternoon session discussing the issue of standards for satellite television transmission (HDTV standards). According to the President, this entire debate was useful since "we are moving towards a consensus" on the Memorandum of Understanding (which will link economic operators), the financing of HDTV and the directive properly speaking. Debate "is moving along at a steady pace," said Mrs. Hanja Maij-Weggen, adding that things "must not be rushed at this point." The President hopes, however, that the "timetable will be very tight," that there will be a first reading in Parliament and that the Council will reach a common position before the end of the year. A special Telecommunications Council is scheduled for 5 December; if this date should prove to be too early, the Presidency could change it. The current directive (which is to be replaced) expires on 31 December: "it could be extended by three months, but it would not be elegant," concluded Hanja Maij-Weggen. Vice-President Pandolfi stated that the Commission would submit a letter of intent giving the main points of the "MOU" before the Parliament session in November. The legal text of this protocol will come at the end of the legislative proceedings. As regards financing needed to launch HDTV, the Commission plans to release ECU5 billion over five years. On the Presidency's request, however, it will check whether this amount is sufficient for the objectives. On this latter point, the Council President said these subsidies would be found by means of shifting funds within the EC budget and not by increasing the latter, as Mr. Pandolfi has agreed.

#### The Council results are as follows.

1) **Application of the Open Network Provision To Leased Lines.** The Council adopted its common position on the directive on this subject, based on Article 100 A of the EC Treaty. This directive will ensure non-discriminatory and effective user access to networks and public telecommunications services with respect to the provision of

leased lines. It sets out the conditions for provision and specifies the nature of leased lines that must be provided in the member states in a harmonized fashion. The planned harmonization will also extend to conditions of use, tariff principles, ordering procedures, supervision by national authorities and conciliation procedures in the event of disagreement between the user and the provider of the leased lines. EUROPE recalls that leased lines are an essential element of public telecommunications infrastructures. They constitute one of the main elements of the telecommunications networks used by companies to meet their own needs or to provide services to third parties, notably value-added or competitive services.

**2) Development of the Common Market in Satellite Telecommunications Services and Equipment.** The Council adopted a resolution which calls on the Commission to present concrete proposals as follow-up to the Green Paper on a common approach to satellite communications in the EC, adopted last January.

**3) Prefix for Access to the International Telephone Network.** Pending the Parliament's opinion, the Council expressed a position in favour of the Commission's proposal aimed at establishing "00" as the prefix for access to international communications throughout the EC.

**4) Standards for Satellite Transmission of Television Signals (HDTV Standards).** The Presidency suggested that the Commission present the draft Memorandum of Understanding to the Parliament (which will debate this important and sensitive issue at its November session) and establish clear financial estimates for the launch of European HDTV, so as to prevent the Parliament, which may take the view that it does not possess sufficient information, from deciding not to express an opinion. The Presidency also raised six questions and, on the first two, the delegations reaffirmed their positive answers. The six questions are as follows: a) Will the HD MAC standard be the single standard for European HDTV? b) Will the D2-MAC standard be the intermediate standard in the 16/9 format for satellite broadcasts? c) What differences will there be in the obligations imposed on satellites at present and future obligations? d) If a TV viewer does not wish to take advantage of the services offered by satellites, will he have to pay for them regardless? e) Is a European deciphering standard needed? f) Should there be minimum Community regulations for cable programmes? Lastly, the Presidency recalled the three areas on which HDTV will have an undeniable influence: i) culture: it will stimulate production; ii) consumers: it is vital to avoid "forcing the consumer's hand"; iii) industry: European industry will benefit from HDTV.

Commission Vice-President Pandolfi recalled that the Commission will alter its proposal following the opinion issued by the EP in first reading. With regard to the Memorandum of Understanding already signed (which represents a compromise among operators active in the

area of HDTV, linking them to the Community solution), the Vice-President told the Ministers "that progress was being made." Concerning financing, Mr. Pandolfi announced that subsidies will total ECU1 billion for five years. ECU100 million are already being provided in 1992 and the remainder will be part of a proposal in good and due form, which will take into account the financial perspectives to be established for the period 1993-1997.

### **European Parliament's Amended Directive on HD MAC Norms Benefits Philips, Thomson**

92WS0169A Paris LE MONDE in French  
22 Nov 91 p 38

[Article by Marcel Scotto: "The European Parliament Amends the Draft Directive on Television Standards"; first paragraph is LE MONDE introduction]

[Text] On Wednesday, 20 November the European Parliament amended the Brussels Commission's draft document on satellite television standards, bringing it somewhat more in line with the concerns of Philips and Thomson. Mr. Filippo Pandolfi, who is in charge of the matter in the EC's executive branch, promised to speak in favor of most of the modifications desired by the assembly before the Twelve's telecommunications ministers who will meet 5 December in the Belgium capital. Furthermore, France and Japan announced the creation of a joint working group to develop systems for converting between one high-definition television standard and another.

The parliamentary bill on satellite television standards was passed with 218 in favor, 78 against (essentially British representatives and a portion of the Italian and German socialists) and 20 abstentions. The vote on the issue gave rise to a grotesque incident. English conservatives—always eager to oppose any Community legislation however unrestrictive—used their tactical skill to pass an amendment which, taken literally, means that the Community will accept competition among several high-definition television (HDTV) standards in its market.

The directive presented by Brussels states—and this clause never sparked the least discussion: "For all HDTV broadcasting that is not exclusively digital, only the HD MAC standard may be used." Catching the majority of deputies, who were called on as usual to vote in haste, in a moment of inattention, the British representatives succeeded in removing the adjective "only." But today's whole battle results from the 1985 decision by EC member states to impose the HD MAC and interim D2 MAC standards, which were developed by European manufacturers, on the entire territory. The move was made to keep Europe's industry from being passed up by the Japanese standard MUSE. This is a significant point to forget. And several European deputies stood up before the assembly on Thursday, 21 November to claim that they had voted for the new bill "by mistake."

Mr. Gerard Caudron (SP) is the author of the report that was presented to the European assembly. He is probably correct in thinking that the incident will have no practical consequence. Any such consequence would require the Commission to make the British "amendment" its own—and the Twelve's cabinet would have to follow its example. Nonetheless, mentalities have undergone a sea change since the first EC directive on imposition of the D2 MAC was adopted in 1986.

That piece of legislation will become obsolete at the end of the year (see 13 November LE MONDE), and given the various metamorphoses that it has undergone, all that remains is to save the furniture. Restrictive bills are out of the question, so great is the opposition to them among member countries. Consequently, most members of parliament have thought about financial incentives to spur radio broadcasters to use the D2 MAC standard and promote the purchase of the 16/9 format. The format 16/9 is the rectangular screen size that is expected to gradually replace those of current televisions. A request has therefore been made that the Twelve's budget be used to provide "reasonable financing" to existing services that agree to expand D2 MAC transmissions. (It is understood that new services will be required to use the D2 MAC standard exclusively.)

Mr. Filippo Pandolfi, who handles the matter for the Community, is thinking about a five-year package of ECU1 billion (7 billion French francs [Fr]) to promote the operation. The problem is that, at this stage, the commissioner has not rallied the support of his colleagues in the Community's executive branch. Many of them are, moreover, skeptical about the willingness of EC budget ministers to open the planned line of credit.

#### **German Company Markets Television That Decodes D2 MAC Signal**

92WS0169B Paris LE MONDE in French  
23 Nov 91 pp. 1-2

[Article entitled: "Grundig Moves to the 16/9"]

[Text] Following on the heels of Thomson Consumer Electronics and Philips, Grundig is launching its first big screen 16/9 television set. The new set will be available beginning at the end of November and will be equipped with an integrated decoder for reception of D2 MAC Paquet (the interim standard supposed to lead to high definition) signals. It is equipped with a 92-cm screen and a 100-hertz dual-scanning device. Grundig is simultaneously launching a second set for 16/9 back projection reception, with a screen that is 142 cm across diagonally. The Nuremberg manufacturer later plans to diversify its 16/9 line by offering sets with smaller—and thus less cumbersome, screens. Like its competitors, Grundig is putting its 92-cm set on sale for 35,000 French francs [Fr].

#### **Netherlands Launches 'Integrated Digital Network'**

92BR0169 Rijswijk POLYTECHNISCH WEEKBLAD in Dutch Dec 91 pp 40-42

[Article by Jelle Kok: "Competitor, Not Trendsetter: IDN Linkup with ISDN"]

[Excerpts] The many advantages of ISDN [Integrated Services Digital Network] services have been discussed since 1980. The technology is available for the infrastructure as well as for peripheral equipment. However, the gradual introduction of ISDN has only just begun. In the meantime, an alternative for switched digital connections was introduced at the beginning of the year in the Netherlands: IDN (integrated digital network). The IDN services package which PTT Telecom is offering across the country, substantially overlaps a number of applications which are designated for ISDN. This is a good reason to investigate what is possible and what is not possible, in particular, as international IDN links are rapidly becoming available.

The UK is ahead of the Netherlands and has offered a kind of ISDN which is comparable to our IDN for some years. Users in the UK have shown considerable interest in this service, especially for various data applications. In most cases it is used for backup purposes.

Initial experience with IDN in the Netherlands also indicates that the backup facility for a 64-kbit/s leased line or other digital connection is useful. This can be performed fairly easily by means of a special adapter which monitors the digital connection and independently constructs a transparent connection via IDN if it is interrupted. The permanent connection may be a digital leased line or a 64-kbit/s channel in a multiplexer or a PABX [private automatic branch exchange]. As the capacity of a connection which is not used for speech between two operating centers is generally used for data, the latter in particular is the most frequent. That is logical; however, the reliability of such data connection depends on the availability of the PABX.

The above cases are one-to-one backups, i.e., each digital connection has its own backup facility. However, n-to-1 applications, where the client's own network management system initializes the backup, are also possible.

#### **Videoconferencing via IDN**

Until recently, video transmission still required broad bandwidths. However, the development of advanced compression techniques has made it possible to apply image telephony or videoconferencing using a relatively narrow bandwidth. [passage omitted]

The systems which are currently available for videoconferencing are mainly used by large organizations, especially for international or intercontinental connections. In order to bring it within reach of lesser gods, standards will have to be adapted. CCITT [Consultative Committee of International Telephone, and Telegraph] is



busy working on this. One of the opportunities that ISDN offers is the use of both B-channels as a single 128-kbit/s channel. For example, 112-kbit/s of the channel would be used for video and the rest for compressed audio, data, and control information. IDN offers the same facility. It does, however, require two separate connections and the possibility of combining both channels into a single channel and to compensate for signal delay.

#### Remote Control and Monitoring of Bridges

Besides speech, image, and data transmission, I(S)DN is also suitable for a number of remote control and monitoring applications. In principle, a normal analog telephone line could do the job, but if sound or video images have to be transmitted, the bandwidth is not sufficient. This is the reason I(S)DN is preferred for remote control and monitoring of bridges and sluices. [passage omitted]

#### Demoproject

At the beginning of the year, the Ministry of Public Works in collaboration with PTT Telecom set up a demonstration project. A test on a larger scale is being carried out involving the remote operation of a bridge. For this purpose, a bridge in Overschie has been fitted with video cameras and control equipment. The remote control functions represent the bridgeman's "hands, eyes, and ears." PLCs [programmable logic controller] which are remote controlled from an operating console, replace the "hands." Video cameras are required for the "eyes" as the quality of regular slow scan techniques is not high enough. In addition, real-time video requires too much bandwidth. This explains the use of compression techniques. As a rule, the installation of four cameras is sufficient and two or more video images are combined in a single video signal. Image selection is process-controlled and image regeneration frequency can be low. Two or four images can be shown simultaneously on a monitor.

The "ears" of the bridgeman play a very important role as the acoustic signal of a ship generally starts the bridge operation process. It is not yet clear what will be used for this function. A microphone is indeed a possibility but it would have to be fitted with a precise threshold circuit. A height detector, an outside telephone, or calls via ship phone or carphone are being considered as alternatives. A combination of these means is also possible. Figure 5 [figure not included] gives an impression of what the equipment for remote control of a bridge via IDN would look like.

#### Pros and Cons of I(S)DN Glass Fiber Transmission

Two things are essential for the remote control of bridges and sluices: automation and communication. Programmable controls, such as those used for several other projects, can be utilized to meet automation needs. Despite the fact that interaction with shipping is subject to extremely high demands, the control function is relatively straightforward

Glass fibers have often been used for communications on the projects which have been realized to date. It is a medium which offers major advantages; for example, with regard to available bandwidth, low maintenance costs, and high level of reliability. Yet, investment costs are high, especially over long distances.

However, I(S)DN is a public infrastructure which is available across the country. This means that the owner does not have to incur high investment costs for the transmission medium. In addition it offers more flexibility. Remote control is also economically viable for distances longer than 5 to 10 km which are generally the rule at present.

A disadvantage of using I(S)DN is the necessity of video and audio compression which increases the cost of equipment which is required on site. Protection is another aspect. I(S)DN is a public network and measures are necessary to prevent misuse.

#### [Box, p 41]

#### IDN Versus ISDN

With (narrowband) ISDN, the user has two 64-kbit/s channels at his disposal via the same physical connection. These so called B-channels are transparent and intended for speech, video, and data. In addition, a 16-kbit/s D-channel is used for signaling or data transmission. A large number of services will be available via ISDN. However, it is the universal access to these various services which is of particular importance.

In the first place, PTT Telecom considers IDN to be a predecessor of ISDN, but it is not unlikely that the system may have a function in its own right. A large number of applications which are not yet possible with ISDN, can already be performed using IDN. Let us take a look at the differences:

- Interfaces: IDN has an X.21 connection with a 15-pole sub-D connector as opposed to the S-bus connection for ISDN;
- Number of channels: IDN has a single channel of maximum 64-kbit/s, while ISDN has two 64-kbit/s B-channels and one 16-kbit/s D-channel;
- Communications structure: IDN utilizes the X.21 protocol which has been around for some time and which is intended for circuit-controlled public networks. ISDN utilizes a new protocol via D-channel;
- Services: IDN is intended exclusively for specific digital communications, whereas ISDN has many more possibilities. Links with similar networks in other countries or with ISDN already exist or will be established in the near future.
- Rates: IDN as well as ISDN have time rates which are related to the normal telephone network system. Start-up costs and monthly rates are higher for IDN than for ISDN. Depending on the distance, IDN is more economical than a 64-kbit/s leased line at an average use of six to eight hours a day.

[Box, p 42]

#### Introduction of I(S)DN

ISDN is currently being tested in Rotterdam. By mid-1992, it will be available in Amsterdam, The Hague, and Utrecht. If everything goes according to plan, another 30 cities will be connected to ISDN in 1993. The rest of the country will follow.

IDN has been available nationwide since March of this year. Special connections to digital telephone systems are used. If the subscriber is not connected to such a system, PTT Telecom provides an IDN connection to another system.

It is already possible to communicate with other ISDN networks via ISDN. The linkup of IDN and ISDN is to be completed in December of this year.

A linkup with a number of other countries can already be made with IDN.

#### Mercedes-Benz ISDN Network Develops Fully Digital Capacity

92WS0179A Heidelberg NET—NACHRICHTEN  
ELEKTRONIK + TELEMATIK in German  
Nov 91 pp 476-481

[Article by Jochen Ewe: "Untertuerkheim's Star Shines Digitally"; first paragraph is NET—NACHRICHTEN ELEKTRONIK + TELEMATIK introduction]

[Text] Since the beginning of April 1991, the telecommunications network of Mercedes-Benz AG at the Untertuerkheim site includes more than 30,000 user connections with a few thousand digital terminal devices. This makes it Europe's largest private telecommunications network. It has 11 digital and nine analog TC [telecommunications] systems at different sites in the Stuttgart region, but is actually viewed and "run" by Mercedes-Benz as one large TC system. In addition to numerous other requirements, the network is primarily implementing the following objectives: better availability of users, better transmission quality, shorter transmission times, and unlimited expandability.

With the replacement of the last relay-controlled EMD-connecting nodes, comprehensive features are opened to all users of the Siemens EMS systems (analog) and Hicom (digital). The TC system in Untertuerkheim is no longer the only telephone node for the approximately 1,500 trunk connections. The systems of both the new company exchange in Moehringen and, most recently, the Mettingen production site have also assumed node functions with their own ISDN trunk connections.

The actual pioneer in the transition from analog to digital was not Untertuerkheim, but Moehringen—as early as 1989. This site selected for the newly acquired company exchange was intended to be equipped from the outset with the latest systems technology. Therefore, Moehringen was linked via S<sub>2M</sub> connections of the

Bundespost via an upstream digital head system to the analog EMS 20000 in Untertuerkheim. It is true that at that time no comprehensive features were linked between the systems; however, it was the beginning of the digital system networking with the advantages of short dialing times, reduced transmission losses, and above all the capability to expand the system beyond the limit of 20,000 connections.

The telecommunications strategy for the acquisition of TC systems, emphasizes Ingo Voigt, head of the electronics department of Mercedes-Benz AG (MBAG) and manager for planning and operation of the TC systems in Untertuerkheim, is oriented toward the criteria of functionality and open standards, operational reliability, efficiency, economy, and protection of investments. What occasioned the move from the conventional analog star networks in favor of more reliable digital meshed networks was the transmission and switching techniques which had become available under ISDN.

This conversion proceeded (and continues to proceed) gradually, making a complete switch-over unnecessary. First, as mentioned, a digital head system was connected upstream to the analog central system in Untertuerkheim and a link was thus made between the analog and the digital world. This step was essential in order to connect additional digital systems planned at various sites and to transfer existing users in Untertuerkheim from old EMD and ESK systems being replaced. From this time forward, all expansions of the system were made and continue to be made in digital Hicom technology.

#### Linking, Networking, Organizing

Continuing on the "gradual conversion" theme, Voigt stresses that with Hicom it would also be possible to move very quickly. Given as proof is the conversion of the nodes in Mettingen. There and in the associated sites of Hedelfingen and Bruehl, three EMD systems were replaced by three Hicom 390's one day during Easter vacation. After only two hours, almost 4,000 users could be checked off as "converted." The checking, testing, and fine-tuning of this conversion were finished a little later.

Naturally it should not be overlooked, Voigt says by way of qualification, that conversions in the communications area are usually not limited to technology alone. Parallel adaptive organizational measures must almost always be taken. In the case of Mercedes-Benz in Mettingen, for example, this involved the changing of 4,000 old phone numbers and the introduction of new features—a process which simply means that good organizational preparations must be made.

The same holds for the subject of employee training, which has been taken very seriously from the outset. The experience garnered at the Moehringen pilot site has thus been incorporated into the other training measures for teaching the functions of the terminal devices. In cooperation with Siemens, Mercedes-Benz also generated

clear and concise basic operating instructions as well as comprehensive user manuals suitable for individual study.

The new telecommunications infrastructure and the careful approach to the requirements of user training is obviously paying off. Thus Siemens operations leader Armin Frase remarks that the individual Mercedes-Benz organizational areas are dealing very intensely with the subjects of voice communications and ISDN services. Frase reports: "Both the passenger car and commercial vehicle plants are increasingly turning to us because they want to find out if and to what extent ISDN meets specification profiles."

#### Universal Planning

"Universality in planning" is the principle (according to Voigt) with which Mercedes-Benz is protecting its investments, to orient itself to the really significant technological innovations and to achieve the most nearly uninterrupted transition from the old techniques to the new. With regard to the goal of interruption-free transition and the assistance from the TC systems suppliers, Voigt comes to the following conclusion: "Siemens must be credited with outstanding service. The technicians were able to again increase the expansion levels of the already fully utilized EMS 20000 so that the connection of the digital head system became possible." And he praises Siemens for reacting quickly and flexibly with the help of project management in those instances when the functions of the Siemens systems did not match the individual ideas of the people from Stuttgart.

Roland Zeininger, group leader for systems planning at MBAG, recalls: "The elaboration of the detailed specifications was not always easy both because of the complexity of the task and the different opinions of those involved, but it was resolvable by working as partners." This is also confirmed by Voigt employee Joachim P. Eppmann who adds: "We presented critical points such as the lack of an electronic notebook on Hicom phones to the Siemens developers who then met our demands constructively. This is also true with regard to the company-specific user interface."

The intense dialogue between Mercedes-Benz and Siemens was the "background music" for an extensive field test of system networking in which the people in Stuttgart subjected the latest Hicom hardware, firmware, and software to comprehensive tests. This field test yielded early detection and subsequent elimination of errors, and Mercedes also formulated specifications. Consequently, the connections existing in the analog PBX system absolutely had to be retained in a digital system.

#### Focus on Ergonomics

The Stuttgart people attached great significance to the subject of "displays and user interface for the terminal devices." Above all, they were concerned that this field not be left simply to the technicians, but to assure the consideration of ergonomic and organizational aspects

in the arrangement and design of the terminal devices and displays. The basic requirement in this was and continues to be that even with new terminal devices the user interface (at least in terms of the most important features) had to remain unchanged.

Furthermore, the employees were supposed to be able to perform their communications activities with PC assistance. This included dialing aids or possibly even the management of competing phone calls. Siemens will offer two PC approaches for this: The transfer of phone book information stored on the PC by interface to the TC system and a PC board with a telephone program which also permits two channel communications.

The Stuttgarters likewise did not want to leave the capability of the ISDN network to perform data transmission tasks unused. "We want to pilot the TCP/IP connection and terminal operation concept with the new Gandalf solution," explains Voigt, referring to Gandalf's data communications server for PBX-assisted datacom. The significance of such data communications via the phone network is clear in the case of Mercedes-Benz because the Untertuerkheim site has 126 outside branches which are installed for the most part in leased office spaces. This situation makes extreme flexibility essential.

#### Decentralized and Centralized at the Same Time

By networking their separately installed TC system nodes, the Stuttgarters utilize the advantages of decentralization without having to put up with its disadvantages. Because this system design provides them a standardized two-digit main extension phone number, plus central fee recording, and a central server as well as a central switching location servicing all sites.

These aspects are of enormous significance in terms of efficiency and costs. This is also true in particular for management of the network. Because monitoring, planning, measurement, and configuration of a network from only one central location entail significant simplification.

#### ISDN Start With Help From German Bundespost Telekom

This is also the case with the new digital switching center which, according to Voigt, "has caught on very well with the women in our switching facility and is a very popular place to work." Voigt cites as the major reason for this the optical display of important data on the screen making necessary information available at a glance. Other reasons are the simple means of recording and billing privately switched calls as well as the ease of learning to work in this facility.

At the Mettingen site, Mercedes-Benz and German Bundespost Telekom were even able to implement a project which is thus far unique in the field of message routing. For this it is essential to know that the node systems in the network have been assigned their own

code numbers—for example, the number 6 at the Mettingen site (with dialing from the "outside" always using 17-6). It was possible because of the new technology to dispense with concentrating all "incoming" trunk calls in one main system, and instead of this direct control of the individual network nodes became possible, it was possible to go back to this phone number code.

"We implemented this on that Easter Saturday in a first step," reports Zeininger. On that day, Telekom separated the number 6 for the Mettingen nodes on the trunk side and has been servicing the affected area directly via the ISDN trunk. "Formerly," declares Voigt, "we had to furnish the 176 lines between the EMS 20000 and the Hicom. With the entry of the Bundespost into message routing, this bottleneck no longer exists."

### Increasing Digitization

According to Voigt, it is important to have a digital direct dialing capability even with the "new" 17-6. Multiple digital S<sub>2M</sub> lines have already been connected—a capability which cannot be offered by the Bundespost for all of number 17 for some time because of the costs. Voigt predicts that before the end of the year approximately 1,000 user connections reachable via 17-6 will be digitized.

An external feature of the conversion in the network from analog to digital technology is the simultaneous use of terminal devices in both conventional and new technology. Voigt employee Hans Glaser, who works in the electronics department as an operations engineer with planning responsibilities, points to an important situation in this regard: Originally there was only coexistence of these two technologies. But since the recent successful introduction of the Hicom 3.1 software series, the former restrictions have been eliminated by the comprehensive features.

### Standardized Interfaces

The digital TC systems are now fully able to be networked with each other, and ISDN features such as call forwarding are available in the entire network. The former coexistence has thus turned into true coordination of the two technologies. In this regard, Glaser says: "This is a respectable development from Siemens which we stimulated with our feedback."

The Hicom network provides the features based on the D-channel protocol CorNet, which Siemens has in the meantime pushed into a de facto European standard. Because for the Stuttgarters it is a condition sine qua non in the acquisition of PBX's and terminal devices to have the potential to select among several suppliers, they observed the standardization efforts of ECMA and of the "ISDN PBX Network and Specification Forum" in this connection with particular interest since in their work these groups have as a goal the capability of multivendor networks.

### Device Standards and Service Concept

One strategy of the electronics department in consultations with the relevant organizational areas is to hold the

number of types of terminal devices used to a minimum. On the digital level an effort was made to use only three terminal device standards because: Fewer types of devices mean less expense for training, installation, and service as well as storage of spare parts, and they also eliminate unnecessary adaptation time when a worker is transferred to a different site.

The servicing of the system complex is handled within the framework of a service concept worked out jointly by Mercedes-Benz and Siemens. This concept is distinguished by the fact that Siemens is responsible for the stability and quality of the operations and systems software and that Mercedes-Benz oversees the system virtually as its own maintenance service, sets up users, and eliminates errors by replacing assemblies.

Of all the many Hicom features, it is the voice mail service (VMS) which the Stuttgarters use the most intensively. VMS is used, for example, as a "super answering service" and gives callers qualified information in puncto Mercedes-Benz Museum. This perceptibly lightens the load of the women in telephone information.

### Use of the Central Server

The VMS is the medium which turns central announcements into an uncomplicated process and assumes the informational function at the time of large switch-overs (such as with the introduction of new phone numbers). Soon the VMS is also supposed to replace the decentralized answering service still in use and will function as a central information pool.

The use of the "PBX and Computer Teaming" (PaCT) is also already emerging with the Stuttgarters in the spectrum of Hicom options because along with the Hicom system, the mainframe mailbox system "Memo" will offer phone direct dialing capability for making telephone connections "from the screen."

Voigt sums up what has been accomplished: "The beginning of service here in Mettingen marks the point in time on which we accomplished what we set out a year ago to achieve: better availability of network users, better transmission quality, shorter transmission times, and unlimited expandability."

### Effects of the Fee Policy

Siemens may have created the essential network management for the operation of the network and Mercedes-Benz may be currently testing it as a pilot customer.

But "it is the fee policy of the German Bundespost Telekom," criticizes Voigt in conclusion, "which forces us in communications service to our external branches to continue to keep our data and voice areas separated. This policy is terribly counterproductive in terms of integrated services. In view of the fact that we have long used combined lines in international communications, it is also not very laudable." Voigt's advice to Telekom: "The monopolist must again share here."



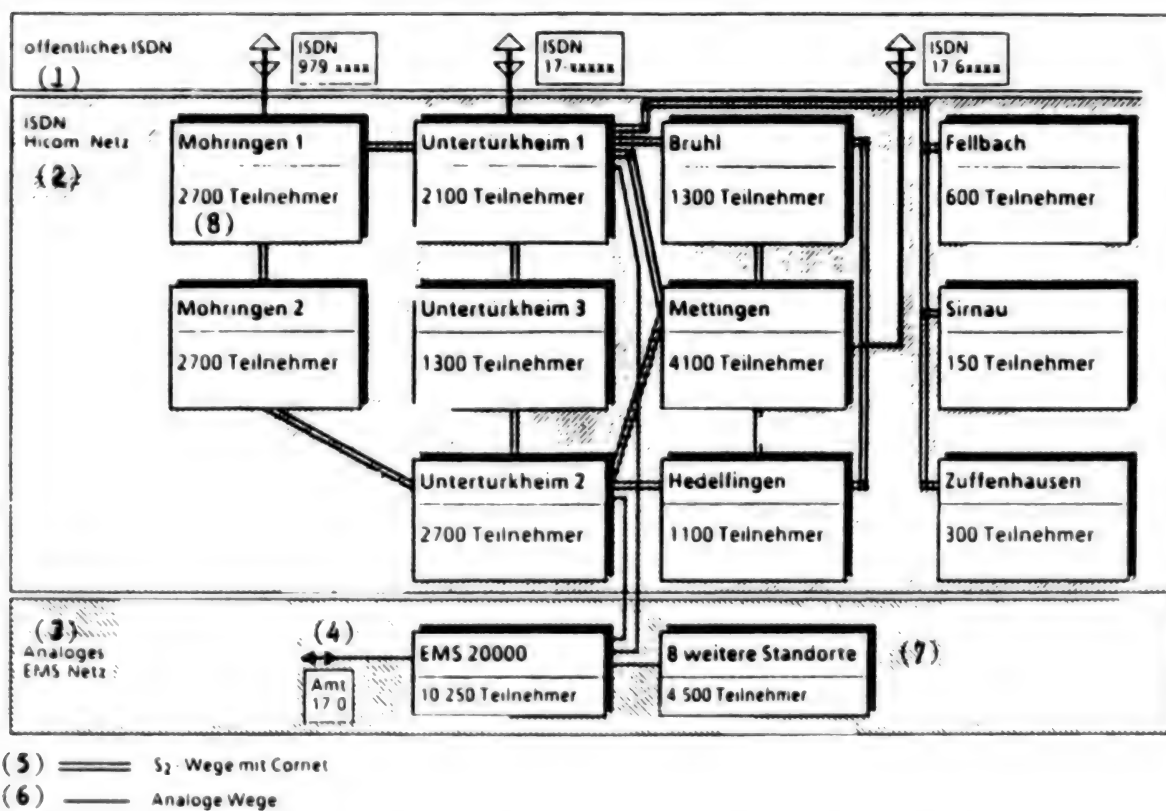


Fig. 1 Mercedes-Benz Telecommunications Network at the Stuttgart Site

Key: 1. Public ISDN 2. ISDN Hicom Network 3. Analog EMS Network 4. 17-0 trunk 5. S<sub>2</sub>lines with CorNet 6. Analog lines 7. 8 additional sites 8. Teilnehmer = User [The top line in each box is the name of the site.]

## COMPUTERS

### **Hungary: Volan Elektronika Software Firm's Activities Reported**

92WS0209A Budapest *COMPUTERWORLD/*  
*SZAMITASTECHNIKA* in Hungarian  
19 Nov 91 pp 1, 7

[Article by Marton Vargha: "Volan Elektronika Divides"]

[Text] Among the division of single-celled organisms, the creation of a new individual, is a sign of favorable conditions and the wellbeing of the colony. It appears that so it is for the Volan Electronics Company as well. One of its leaders, Kalman Faur, business director of Mikro Volan Electronics Ltd., has reported on the status of the firm. We learn that Volan Elektronika, which operates as a holding company, has 21 interests, two of which are stock companies and the rest limited liability companies. The 350 workers produce 1.2 billion forints in receipts each year, without the cross deliveries. The property—with real estate and investments—can be put at a billion forints. They have no debts, there is nothing outstanding, but they have put out capital themselves. All this together shows that Volan Elektronika is securely guarding its positions on the uncertain Hungarian computer technology market and will continue to be competitive.

Income from sale of software they have developed themselves makes up half of their receipts. According to Kalman Faur this is the basis for the stability. Ten limited liability companies work in this area, many of them in the traditional transportation market where they prepare production, business and shipping programs or operate them for transportation enterprises and autobus companies. Even including auto repair shops this market is relatively restricted, one can count on only a few hundred potential customers.

The commercial activity of Volan Elektronika is constantly expanding. They are proud to be authorized retailers for Rank Xerox because, as Kalman Faur said, the competition is hard and only those stay on their feet who are reliable partners for customers and buyers. There is also significant trade in accessories.

The cut back in the traditional large computer market is shown by the fact that in 1992 the Siemens BS2000 twin system will probably account for only 2-3 percent of the receipts. But a Canadian-Hungarian limited liability company was formed during the summer to enter the Hungarian market as agent for the AS 400. The strategy of the new undertaking is based on the recognition that for the time being AS/400 software updating is weak in Hungary. They will try to adapt the Canadian experiences here at home.

A new item from the MVE is network business software which supports data security with automatic correction. Kalman Faur pointed out that data security is a basic requirement for various bookkeeping operations and that in case of a power outage NetWare "throws up its hands," which is unacceptable in this area. Their newest developments confirm—perhaps—the security factor in that in

these programs only 15-20 percent does the real work while the rest serves data protection.

They support schools, especially those which teach accounting and bookkeeping. Programs which they have provided free, and the textbooks for them, are used in 150 schools already.

In conclusion Kalman Faur talked about the new accounting which will be valid in 1992; the situation is still uncertain, there will be no time to learn it and get it going. The lack of suitable state administrative preparation will cause a lot of difficulties.

### **Hungary: Prime Minister's Office Chooses Open Systems Network**

92WS0246A Budapest *COMPUTERWORLD/*  
*SZAMITASTECHNIKA* in Hungarian  
26 Nov 91 pp 1, 3

[Article by Sandor Mester: "Decision for Open System"]

[Text] At a press conference on 15 November Gyorgy Szilvasy, deputy state secretary for the Prime Minister's Office, announced that the competition announced for the automation of the office has been closed. Bids were submitted by 29 domestic and international informatics enterprises. There were five in the second round—Bull, DEC, ICL, Montana-Compaq-Microsoft and Olivetti. Finally, according to the decision of the judging committee made up of western European and Hungarian experts and members of the office, the Montana-Compaq-Microsoft consortium won the contract. The deputy state secretary emphasized that all of those in the second round were capable of solving tasks at a similar level.

The proposed solutions for installing the network were evaluated separately. Of these the experts gave first place to Optotrans Ltd., with headquarters in Vac, which recommended the BICC system.

In recent years, Mr. Szilvasy said, government organs and the local self-governments developed their informatics systems independently of one another and a communications link among them did not come into being, due to a lack of compatibility among other things. He admitted that at that time technical and political (Cocom) limitations hindered the creation of modern systems.

"When the new government took office," Mr. Szilvasy said, "the computers in the prime minister's office were put together from Far Eastern parts and a network did not exist." Nor did these computers meet the most basic technical requirements, such as requirements (security, for example) that were natural due to the essence of government work.

"With the removal of the provisions forbidding the import of modern technology and thanks to the international standardization trends we were able to bring about a qualitative turn in administrative informatics," the deputy state secretary emphasized. The government created an interministerial informatics committee which had the task of formulating a strategy which met the European requirements—primarily the standardization requirements

adopted in the European Community—and of coordination among the state administrative organs and between state administration and the power spheres coming to be linked with it. In addition this committee sees to it that there should be coordination in regard to applications between the customers, the state administrative organs, and the vendors, the informatics firms.

Adapting to international experience the interministerial committee decided for open systems in regard to informatics development of central government organs. When announcing the competition it was a basic requirement that the contenders provide for cooperation of UNIX and MS-DOS based systems, that the users should have a Windows graphics surface and that the Informix, Oracle, DB2 and SQL tools be available for database management.

"Our backwardness is not significant. The use of open systems is just getting started even in western Europe," Mr. Szilvasy said. "The decision for open systems, at least in regard to government applications, may cause a restructuring of the market and change our value judgments about various computer engineering firms," he added. He emphasized that both the interministerial informatics committee and the Prime Minister's Office were clear about what would define their informatics developments in the near future—adapting to the European standardization processes and bringing in western European experts. "Our goal is to provide the greatest freedom for users of the system so that they should not be at the mercy of any hardware or software manufacturer," the deputy state secretary said.

The honesty of tenders in Hungary is often questioned. Mr. Szilvasy considered it important to emphasize that the competition of the Prime Minister's Office was evaluated without bias, with the cooperation of qualified experts. "We would like this competition to be a model in informatics," he said.

Geographically the electronic link between the building of the Prime Minister's Office (Number 4, Lajos Kossuth Square—the Construction Ministry worked here earlier) and the Parliament will be the first step in the network being created and this will determine the line of development in the years ahead.

Gyorgy Szajbely, managing director of the Budapest limited liability company of Montana, said that first four local networks will be set up: Compaq SystemPros with various structures will operate in these. Experts from Montana GmbH and the Budapest Montana who prepared the winning plan had to solve the problem of how to serve nearly 70 work sites (Compaq DeskPro). The four LANs will be connected with one another; various UNIX versions of SCO and Microsoft Lan Manager will create the network environment for the applications. Window type Microsoft applications will run at the work sites. Mr. Szajbely said that thanks to concessions by providers in the second round (Compaq, Microsoft, SCO) Montana was able to submit a price bid which stayed within the available costs framework.

Ilic Zelimir, leader of the group responsible for the eastern European business of Compaq, said that his enterprise came out first in a clean competition. He considered winning the tender to be a great success as Compaq has been on the Hungarian market for hardly more than one year.

According to Zsolt Szaloczy, business director of Optotrans Transmission Technology Ltd., a private undertaking founded a year and a half ago, his firm won the competition to install the network because the customer decided on an open system independent of manufacturer and the BICC has the technical solutions to meet such requirements. Optotrans will create an Ethernet surface which will make possible cooperation between the Compaq computers, the varied UNIX software of SCO and the Microsoft programs. The network to be installed will have the features needed to satisfy the requirements of flexible expandability and a high degree of data security. In the Parliament building they will set up a fiber optics network according to the "fiber-to-the-desk" principle, right up to the work site terminals. A solution developed by BICC will provide hypersecurity. This avoids the disadvantage of Ethernet networks that with them, data go to every work site, because of the serial bus. The BICC system sends packets in decodable form only to those work sites to which they are addressed. In the first stage the network will have a transmission speed of 10 megabits per second—fiber optics in every essential branch—but later this can be sped up to 100 megabits per second.

In answer to questions Mr. Szilvasy said that implementation will be covered largely from the budget—an insignificant sum was obtained via competition. Asked how much the system will cost the deputy state secretary answered that this year the Prime Minister's Office will spend 50 million forints on informatics developments, and that the project under discussion is part of this. Pal Vadasz, one of the leaders of Montana GmbH, said that according to the contract the system will be in operation by the end of December or beginning of January.

#### Transparent Networks, note by Gyorgy Csanyi

Optotrans Ltd., the Vac company formed last year, deals primarily with design and installation of optic fiber transmission links. They offer optic fiber solutions for both computer and communications networks. They provide the glass fiber, various connections, etc. for the links.

The company also works as system integrator for BICC Data Networks. Their work thus far, their reference sites, can be found primarily in our universities. They are working on creation of an 8 km optical network to link the schools and departments of the Lorand Eotvos Science University and on setting up an optical trunk line at the Horticultural University. They are doing similar work for the Economics University. They prepared the first experimental optic fiber communications of the MAV [Hungarian State Railways] between Miskolc and Nyekladhaza.

### **Hungary: 1990 Computer Technology Statistics Reported**

92WS0246B Budapest *COMPUTERWORLD/*  
*SZAMITASTECHNIKA in Hungarian*  
26 Nov 91 pp 17, 18

[Article by Mrs. Andras Sulok: "Hungarian Computer Technology Panorama for 1990"]

[Text] The 1990 statistical data pertaining to Hungarian computer technology were published at the end of October. In what follows we publish the figures in the chief categories and a terse analysis of the phenomena observed.

#### **Growth of Computer Inventory**

Following a decrease experienced already in the preceding year the rate of growth in the inventory of computer tools moderated further in 1990. By the end of the year the computer inventory of the institutions providing data exceeded 120,000 units and the gross value of the inventory exceeded 51 billion forints. It is characteristic of the rate of growth that while the number of computers increased by 25,000 between 1987 and 1988 the increase hardly exceeded 12,000 units between 1988 and 1989 and in 1990 it was a little over 18,000 units. The volume of the increase fell to practically half of the earlier one. The increase in gross computer inventory did not reach 75 percent of what it was two years earlier but it surpassed the previous year by nearly 50 percent.

Investment data also indicate a change in inventory. Only a small drop could be experienced in 1989, the magnitude of the decrease did not reach half a billion forints compared to the preceding year. In 1990 computer technology investment was less than two years ago by 1.1 billion forints and was less by nearly 900 million than the preceding year.

The gross value of the computer technology inventory did not increase further in this year. In contrast to the 20-25 percent growth experienced in earlier years it did not reach even 8 percent in 1989 and there was 3.6 percent gross value decrease in 1990. In addition to actual investment the changes were influenced by computer acquisition beneath the fixed asset limit value (50,000 forints), which gradually increased in recent years. As is well known, microelectronic equipment and complete, high powered microcomputers can be built up out of subassemblies beneath the fixed asset value limit and due to this they are not recorded as fixed assets.

If we compare the two contradictory trends it is probable that the decrease is really of smaller magnitude than can be computed on the basis of computer technology statistics pertaining primarily to fixed assets. Taking into consideration the combined effect of the large scale organizational changes, the acceleration of privatization, the reorganization of central and local state administration and other factors it is very probable that the actual increase in inventory is greater than can be demonstrated. We come to the same conclusion if we examine the growth in the world computer technology market. On the Japanese market, a good bit more saturated, the growth rate of the computer

technology branch has not slowed (it was 28 percent in 1988). The situation is similar in western Europe too, where they measured 14.8 percent in this same period. Considering the annual trade in computers in the PC category, Finland produced more than six times that of Hungary!

The ratio of microcomputers increased further, in gross value the increase exceeded 48 percent. On the other hand, the restructuring of the computer inventory according to performance category came to a halt. The share in the small and medium category continued to decrease (falling to 23.8 percent from the earlier 24.9 percent) but the ratio of mainframes increased to 3.9 percent from the earlier 3.1 percent. The primary cause of the change is that a regrouping among value categories is taking place—as a result of changes taking place in the price of computers. The higher performance PCs and workstations (according to value) are shifting into the small computer category while the mainframes are being replaced in general by cheap, used IBM computers, which increase the inventory of medium computers according to their value category.

#### **Distribution of Inventory by Economic Branch**

Industry continues to maintain its leading place among computer users. At the end of 1990 more than 30 percent—measured in gross value—of the computer technology tools operated here. The computer technology share of the construction industry, trade, water management, state administration and health stabilized. No substantial ratio shift took place in these areas. Trade and telecommunications show a slow, continual winning of ground which could be observed for years. The service branches, to which institutions providing computer technology services also belong, possess about 20 percent of the computer technology tools, but even last year we could see a slow but continuous loss of ground, which began three years ago.

#### **Regional Distribution**

A slow movement to the benefit of the provinces, which could be shown for years already, continued in the distribution of computer technology tools between Budapest and the provinces. The provincial share exceeded 44 percent in 1990 (compared to 41.2 percent in 1989). In regard to the number of computers being put into operation the predominance of Budapest ended in 1984 but the experience is that the provinces are overcoming their earlier disadvantage with great difficulty, on the basis of the number of computers they reached a 55.9 percent share in 1990.

#### **Distribution According to Origin**

The composition of computers according to origin reflects the effect of market changes, indicates the new acquisition sources and permits one to conclude that a stable structure is developing. A further restructuring can be expected in the mainframe category where the ESZR and MSZR [standardized socialist series] computers being scrapped are being replaced by used IBM and larger category VAX computers. It also indicates the structural change which



has taken place in inventory composition that in a series ranked by net value, the ESZR and MSZR machines do not figure in the by 20th place. For example, the R45 machines were moved back to 25th place. The IBM PC/AT figures in the inventory in the largest proportion. In ranking machines according to total net value the Commodore 64 is still among the first ten models (although it fell to ninth place compared to sixth place in 1989).

The total number of computers was 19,796 in 1985, 38,804 in 1986, 90,326 in 1988, 102,776 in 1989 and 120,977 in 1990. A percentage breakdown by origin for these years shows 29.4 percent domestic, 12.0 percent socialist and 58.6 percent capitalist in 1985; 23.1, 6.9 and 70.0 respectively in 1986; 29.8, 2.6 and 67.6 in 1988; 29.4, 2.4 and 67.7 in 1989; and 30.1 percent domestic, 1.1 percent socialist and 68.8 percent capitalist in 1990.

#### Age Distribution

The change in the market situation, the relative stability of the acquisition channels which have developed and the constantly large sum in new computer technology investments have resulted in a more even age distribution. The ratio of "over age" computers, operating for more than 10 years, decreased and 93.2 percent of the machines are younger than five years old.

The age distribution of computers is as follows: 41.5 percent one-year-old; 17.4 percent, two; 16.7 percent, three; 12.4 percent, four; 5.2 percent, five; 3.5 percent, six; 1.4 percent, seven; 0.3 percent, eight; 0.2 percent, nine; and 1.3 percent over 10 years old.

#### Organizational Forms

Increased mobility is a lasting feature of businesses conducting computer technology applications activity. This branch was always open to what was new, provided an arena for reform thinking, and always exploited the possibilities offered by new organizational forms. Last year, in accordance with the prescriptions of the transformation law, the initial large number of PJTs (civil law associations), GSK's [economic work groups] and later small cooperatives were transformed into limited liability companies or joint stock companies. Nor were the traditionally leading firms of computer technology left untouched by organizational change, these also have been gradually, and in many steps, reorganized into limited liability companies and interest holding groups. This process continues vigorously even today.

#### Sales Receipts, Trade

The sales receipts for computer technology applications activity decreased from 44 percent in 1989 to 40 percent in 1990 in the enterprise form while the share of limited liability companies in this trade increased further. Last year, trade in purely computer technology applications products and services exceeded the 1989 figure by 14.8 percent and came to 11.8 billion forints in 1990. (This does not include sales receipts for microcomputers although this area constituted the largest segment of the computer technology market this year as well.)

As a result of the accelerated organizational transformation of the enterprises the rank ordering, according to computer technology receipts, changed fundamentally also. Organizations which carried out organizational decentralization earlier fell back in the rank ordering or do not figure among the first 25 (for example, the EGSZI [Institute of Construction Management and Organization], the SZUV [Computer Technology and Management Organization Enterprise], etc.). The decentralization which continues in 1991 will probably completely change this enterprise ranking. A number of enterprise conglomerates such as the EGSZI, the Szamalk, the SZUV and other groups, appeared in domestic computer technology last year. But their place in the rank ordering cannot be evaluated—with the exception of Szamalk, which occupies the fifth, sixth, 10th, 15th and 19th places.

The transformation of the structure of computer technology expenditures continued, to the benefit of software; its market share was greater than 26 percent in 1990. The export of computer technology applications products and services shows a constant but slow and small growth. It is probable that undertakings not included in the state statistics developed at a faster pace in the past year than did the state enterprises so their market share will be ever greater.

#### Employees

A decrease appeared in the area of computer technology employment. On the basis of data from firms employing a computer technology workforce approximately 28,000 computer technology employees were recorded by the 1990 statistics. Computer technicians working as full or part-time workers in small undertakings can be estimated as an additional 9,000 persons. The increase in the number of computer technology employees ended this year, and they even decreased by about 2,000. This is partly a consequence of the fact that with the spread of microcomputers, the operation of computers is increasingly out of the hands of computer technology employees (they are limited primarily to software development or to providing services). In part it is a consequence of employment problems. In the future we must reckon with an increase in unemployment among computer technology employees as well.

#### Use Areas

The applications areas for computers continue to show that both the mainframes and the microcomputers are used primarily for accounting and financial processing and record-keeping. In this respect the distributions of the small computer and large computer areas have not differ substantially from one another. At the same time, text editing occupies a very prominent place in the frequency of microcomputer use.

On the basis of data available from studies made in the sphere of state statistics it can be stated that the rate of growth of computer technology use came to a halt in 1990 and fell in certain areas. Other signs indicate, however, that the increase in organizational mobility, the expansion of the sphere of hardware vendors, the boom on the world

market and the growth could be higher than the statistical indicators, but the survey does indicate a real halt. The presumed difference may derive from the problem of the difficult approach to areas falling outside the sphere of statistical observation.

### **Bulgarian Scientists Developing Optical Computers With Hologram-Like Components**

92W.S0260C Duesseldorf VDI NACHRICHTEN  
in German 27 Dec 91 p 23

[Article by Peter Lange: "Paths to the Optical Computer: Synphasic Optics Amaze With Unusual Properties"; first paragraph is VDI NACHRICHTEN introduction]

[Text] Munich, 27 Dec (VDI-N)—Optical computers, an old dream of many computer scientists, are to become a reality with hologram-like components which have been developed in Sofia. These belong to the field of "synphasic" or "in-phase" optics and include, for example, even microstructured plates which can have arbitrarily many foci along their optical axis.

Synphasic components, explains Professor Metodi Kovatscheff of the Bulgarian Academy of Sciences, differ quite significantly in several aspects from conventional hologram plates, since it would, for example, be possible to work with "spatially as well as temporally incoherent light of differing wavelength ranges" and even with ordinary white light. Reportedly, it would be possible to produce plates which have foci distributed on a surface or even in space, or even structures in which the "focus" would have the form of a ring.

Kovatscheff's strange plates, a few of which he recently presented in Munich, are based on microgroove structures with a sawtooth-like cross-section which are photolithographically produced and differ from conventional hologram grooves because of their right-angled cross-section. But additionally, the "saw teeth" of the synphasic optics are also "approximately three to ten times as deep as the wavelength of the light"—so that the light aberrations which normally occur—"and particularly the chromatic light aberrations"—extinguish each other mutually and it thus becomes possible to "develop very precise optical systems with completely new properties." And, in fact, as Kovatscheff insists against objections in a technical discussion, "systems which have not previously been known."

Perhaps the most spectacular application of the optics according to Kovatscheff's formula could be neuron networks which are currently familiar especially in the design of electronic systems and which in their mode of operation are reminiscent of simple biological brains.

Kovatscheff explains that even the best one- or multi-layer optical neuron networks of conventional holographic technology could at best someday achieve a calculational throughput corresponding to one ten-thousandth or at most one-fifth that of the human brain. However, using synphasic technology, it is possible to produce a plate which could make no less than  $10^{30}$  connections (!) between the points in two volumes, a number which supposedly corresponds to the number of connections in

the human brain. This would ultimately result in calculational throughput which would be approximately 1 million times greater than that of the brain.

However, the special optical properties of the structures developed in Sofia also enable coupling multiple plates with these and similar properties and thus to also construct interleaved network structures; here again the plates with multiple foci located on their optical axis could be of use. Furthermore, these multifocus structures would make it simple to link the results from such an optical system to specific points.

Moreover, according to Kovatscheff, at least in theory, neuron network structures are conceivable which could perform approximately  $10^{30}$  microoperations per second (mips; not to be confused with the mips from computer technology, which means millions of instructions per second). And here one should really be pleased, comments the Sofia expert, that with such a system "each microoperation does not require at least one photon", since if that were the case, it would be necessary "to activate billions of atomic bombs to power such a system."

To the contrary, in reality, explains Kovatscheff, in synphasic optics internally—and purely arithmetically—only fractions of a photon are "used" per microoperation, so that only with the output of data would a large energy problem occur.

One thing is comforting in the reports: It is still possible to hope that man with his error-prone, forgetful, and sometimes completely misguided brain will continue for many years to be the apex of all "thinking" structures on this planet.

### **Photo Caption**

Scientists work on the development of computers which operate with photons instead of electrons. However, the dream of the optical computer has not yet been realized beyond the laboratory stage, as this photograph of research at the Imperial College in London reveals.

### **Hungary: Unnamed Consortium Buys Videoton**

92W.S0271B Budapest HETI VILÁGGAZDASÁG  
in Hungarian 14 Dec 91 pp 18-19

[Article by Pal Rev: "Videoton Has Been Sold. The Spoils of War"]

[Text] Videoton is dead, long live Videoton! After Ikarus the new attempt to resurrect Videoton also indicates that the market, the competition, the change of system, the collapse of the Soviet Union and the linkage to Europe all together are not enough to provide a radically new direction for the profiles or market strategies of the giant state enterprises. That certain "geopolitical reality" is at most only taking new forms.

The Soviet market is not lost, it is only being transformed, take some of the hair of the dog that bit you.... Videoton went on the block more than a year ago due to the collapse of its two chief markets, the Soviet Union and the socialist munitions industry, and its new owners, victorious at last

week's auction, are counting on getting the firm out of its fix with the aid of these two chief markets, they are expecting orders primarily from the former Soviet republics and the former socialist munitions industry.....

There were 59 offers in the auction announced in October by the Reorganization Organization entrusted with liquidating the eight enterprises and 11 investments of the Videoton Group, but most of these offers pertained to purchase of only this or that smaller unit and even added together they promised only 1.2 billion forints as opposed to the 14.5 billion forint announced price—the book value of Videoton. (In September the leader of the Reorganization Organization put the value of VT [Videoton] at not more than 10 billion forints and the members of the Quatro private investment group, the only ones making an offer then, estimated it at 5-7 billion forints at most.). At the present auction this latter association represented one of the three bids with the best chance, a total of 4.4 billion forints, 190 million of this in ready cash and the rest in bonds, to buy the erstwhile giant of the Hungarian electronics industry, undertaking to employ 5,000 of the 8,600 still working there today. Another group, not wanting to name itself but allegedly bidding with American capital, would have taken the "Vidi" for at most 3.5 billion forints in ready cash and would have assumed responsibility for the employment of 8,500 people.

The winner, finally, was a third consortium, nameless for the moment, which is buying the enterprise group for 4 billion forints ready cash and assuming responsibility for employment of 6,000 people, according to an already signed preliminary contract. The Hungarian Credit Bank is holding the money for the consortium and will pay the 4 billion by May of next year, 200 million being due this week already. The other members of the investment group have offered intellectual capital as their contribution. Of these Gabor Szeles, owner-president of Muszertechnika Rt. [Instrument Technology Company], will have a 10 percent share in the Videoton Group, his colleagues at Muszertechnika, Peter Lakatos and Otto Sinko, will have 4 percent together. Euroinvest Kft., will have 5 percent and the chief share holder will be the MHB [Hungarian Credit Bank] with 81 percent.

The organizer of the consortium, which took the name Euroinvest Kft. in September of this year, was known earlier under the name Central European Investment Company (CEIC), as a member enterprise of CEIC holding, led by Sandor Demjan and owned by Canadian Hungarian capitalists—the Reichmann family and their adviser Andras Sarlos. The holding has a 55 percent share in Euroinvest Kft., 45 percent being owned by the MHB, which in a separate contract entrusted Euroinvest with "saving" its loans "frozen" earlier. One of the biggest fish in this deal is precisely Videoton, which at the time of the August initiation of the liquidation process owed the bank 11 billion forints. As director general Sandor Nyul told HVG [HETI VILAGGAZDASAG], Euroinvest succeeded in convincing the leadership of the bank that if it would throw in 3 billion to the approximately 1 billion forints coming to it in the course of the liquidation process then it

had a chance of getting back, within a few years, the 10 billion now lost. At one time the MHB, as the largest creditor of Videoton, "muddled" by more than 25 billion forints, gave up becoming owner of the Vidi by changing its loans into shares, because it considered the possible litigation with the other creditors too risky; but thanks to the liquidation Videoton became free of burdens.

The "brains" of the consortium is Gabor Szeles, who will be president of the director's council of the enterprise group which is expected to continue to bear the name Videoton. With the aid of a deal "so far unknown in Hungary" he will have a 10 percent ownership share. As the star manager told HVG, after the signing of the final contract, due on 20 January, the contract will be made public—indeed, it is intended for general edification—and will provide an example of how domestic managers, suffering a shortage of ready cash, can "capitalize" their managerial expertise and, by risking their good reputation built up over their entire careers, and with the aid of a bank, can become owners of state property.

According to a complicated table "copied" from an American business textbook, Szeles undertook to show how Videoton will increase its profit, trade and the price of its shares in the next three years. If this does not happen then shares worth 100 million forints (enumerated in the agreement to be signed) will become the property of the MHB, out of the Muszertechnika shares package, owned by Gabor Szeles. "But the real disaster would not be that I lost that 100 million," the future Videoton president told HVG, "rather it would be my moral disaster as a manager, which naturally would entail a collapse of the Muszertechnika shares prices."

The first trip by Szeles, victorious in the auction, who in any case started with at least a two-thirds chance as a member of the Quatro group, which came in second, led to Moscow at the end of last week. There he was given a promise by Arkady Volsky, responsible for reconstruction of the Soviet munitions industry (HVG, 31 August 1991), that Videoton "would be considered" during the "reconstruction to be carried out under American control." With written authorization from Volsky in his possession Szeles, as he told HVG, can discuss the deal with leaders of the American army directly as well.

The number one manager of the Hungarian electronics industry returned to Budapest for an in-house celebration of the 10th anniversary of the existence of Muszertechnika, founded by him, and flew to Israel the next day—primarily for the purpose of laying foundations for munitions industry orders. "By taking over the military electronics being manufactured in Israel on the basis of American licenses it might be possible to modernize the Hungarian army relatively cheaply," Szeles said. "For example, the 'dumb' tanks being used now could be renovated with a so-called fire control unit."

The new owners will devote "only" 20-30 percent of Videon trade to the munitions industry, as opposed to the earlier 50-60 percent, while 30-40 percent would go to TV

manufacture and entertainment electronics and the remainder to chip manufacture and production of local telephone exchanges.

As for markets Gabor Szeles recognizes that for the time being the firm will be forced "in the direction of least resistance," that is, starting toward the East. According to the director general of Euroinvest, who got into the deal not least of all thanks to his good (ex) Soviet contacts, especially Bashkir and Tatar, Videoton has a chance to deliver complete truck electronics for the Kamaz truck factory to be privatized by the CEIC and, by building in picture tubes made in Bashkiria, of selling another 300,000 TV sets next year, after 75,000 this year, largely in the Soviet Union. Szeles is counting primarily on the contacts of the Demjan group in "pumping out" the sales price in the form of oil.

## FACTORY AUTOMATION, ROBOTICS

### Czech TTC 2000 Telecommunications Gear Described

92WS0223A Prague SDELOVACI TECHNIKA  
in Czech Nov 91 pp 436-437

[Article by Karel Mrhal: "TTC 2000 Telecommunications Equipment"]

[Text] The TTC 2000 is a modern, universal telecommunications system that has been developed, and is currently being manufactured at TESLA Telecommunications. It has an open, modular architecture down to the individual module level, all of which are pull-out units. The modules have a uniform interface which makes possible flexible modifications of the system for a broad range of applications. The system supports the connection of broadband channels of up to 384 kb/s. The modules of the TTC 2000 can be combined to form a wide range of telecommunications equipment, for example switching centers and their related multiplexing equipment.

The available TTC 2000 system modules make possible:

a) The design of peripheral telecommunications equipment for connection to the public grid, such as:

- Digital concentrators;
- Small switching centers to connect to the public network;
- Private branch exchanges;
- Hotel exchanges;
- Centrex exchanges;
- Exchanges for mass radio networks.

b) The construction of company networks in the power generation sector, in transportation, in government administration, as well as the construction of networks for private companies with territorially dispersed operations (virtual network).

The TTC 2000 is appropriate for the efficient introduction of telephone service to areas on the periphery of the telephone network, with connections to analog exchanges which will continue to be used in the later phases of construction of the digital network, through connections to

digital switching centers. During the transition from an analog network to a digital network the equipment can be upgraded to support ISDN services. This brings other economic advantages when connected to the telecommunications network. The TTC 2000 system allows progress to be made in small steps. The wide range of modules makes it possible to implement ISDN optimally, by evaluating its efficiency and effectiveness at each step.

If the equipment is implemented initially for telephone communications, the same equipment can be upgraded at a later phase with modules for data or text communications. The equipment is not exchanged, but only upgraded, meaning that the investments made at each step are fully utilized to meet growing telecommunications demands. A wide range of interface modules makes it possible to upgrade the equipment to operate in conjunction with older exchanges, allowing adjustments to be made during the digitalization of the peripheral network.

### Network Configuration

The TTC 2000 system has been designed for the building of enterprise (private) networks covering wide areas, and which form a virtual network within the public network. These virtual networks operate for a single exchange, independently of any higher exchanges in the network. The configuration of a single exchange can run from 8 Pp to 2,000 Pp. The peripheral telecommunications equipment can be connected to the periphery of the public network in any configuration.

### System Functions

The wide range of functions available with the TTC 2000 system allow the outfitting of even the smallest exchange. The system supports the installation of a high performance control subsystem for even a small number of connections. The group control module consists of a 16-bit microprocessor with 640 kb of memory, 128kb of which is reserved for resident programs. The performance of the control component can be increased with other modules, which operate independently and communicate with each other over an 8 megabyte per second bus.

Each system is equipped with basic functions and can be upgraded with supplementary functions based on user requirements. Program packages for different system configurations will be available in 1992. The software that will be available in the first stage includes software for:

- a) Telephone channel commutation
- b) Data channel commutation, up to 9.6 kb/second.

Telephone channel commutation is possible for:

- Internal communications;
- Outgoing semi- and fully automatic communications;
- Incoming communications, including direct inward dialing into an exchange;
- Transit communications.

On the subscriber side, the basic system configuration provides the following services:



- Direction and redirection of calls;
- Call backs;
- Conferencing;
- Consultation calls;
- Abbreviated dialling;
- Automatic call back;
- Group dialling;
- Emergency connections (with highest priority);
- Radio conferencing;
- Ring-when free mode for end of busy signal or a free line.

The basic functions include subscriber categorization based on:

- Authorized access to subscriber services;
- Authorized access to information;
- Authorized access to long distance subscribers: (category of intercity and international calling).

A number of additional functions not related to communications can be installed in cooperating computers or, for smaller systems, into personal computers at a site for supervision and operation.

#### **Diagnostics and Maintenance**

The TTC 2000 equipment comes with automatic monitoring of the functions of every module. These installed diagnostic procedures detect and isolate errors at the pullout module (board) level. An alarm goes off on the affected board. Upon request a diagnostic program at the service location issues the same message. Operation and supervisory workstations combine the functions of:

- Operator;
- Incoming/outgoing calls;
- Communication monitoring;
- Collection of operating data;
- Diagnostics;
- System reconfiguration;
- Modification of service categories;
- Fee assessment for calls.

These workstations are made up of a PC/AT computer with 20-80MB hard disks, based on the scope of installed functions. Small installations can use a touch tone telephone with a display.

#### **Components and Power Supply**

The equipment uses state-of-the-art telecommunications and standard components made by leading component manufacturers (SGS Thomson, National Semiconductor, Vicor, etc.), which assures high reliability and low equipment down time, as well as low electricity consumption per Pp.

Power supply is handled universally:

- For 220 V grids, +10 percent to -15 percent,  $f = 50$  Hz;
- For 24V/48V/60V exchange batteries, +20 percent to -10 percent

The network can be backed up by connecting it to a rectifier with a gas-proof, 24 V battery (for example, manufactured by the firm ALTECO).

Equipment power consumption is about 240 W for a 190 Pp facility, and about 150 W for a 96 Pp facility.

#### **Noise Suppression and Resistance to Excessive Voltage and Current**

The equipment suppresses noise in conformance with Czechoslovak State Standard [CSN] 342895. In terms of resistance against external electromagnetic forces, it complies with IEC standards 801-2 through 801-5, in categories required for power generation facilities.

#### **Mechanical Parameters**

The equipment is installed in a case that corresponds to IEC standard 297. The size of the pullout modules (boards) is 6 U, or 233.5 mm x 280 mm. The boards are inserted into a rack that has 20 positions, 20 mm apart. Two racks are located in a single, lockable case, and are considered one block. The capacity of a single block is 240 lines for nf telephone sets, including the connections for the nf connecting lines. Free positions can be used for attaching LAN networks, data terminals, digital line links, information boxes, etc.

The ratio of data to telephone modules can be changed. A block can be equipped, for example, to serve as a data exchange, with a predominance of modules for data connections, and a small number of telephone connections (from 8 Pp).

By connecting blocks communications equipment can be created to support 2,000 Pp.

**END OF**

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